

ATLAS PORTLAND CEMENT

for
CONCRETE



Its use around the
home and on the farm

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ATLAS PORTLAND CEMENT

for

CONCRETE

*Its use around the home
and on the farm*



*"The Standard by which
other makes are measured"*

THE ATLAS PORTLAND CEMENT COMPANY

25 BROADWAY, NEW YORK, N. Y. 409 N. 7TH ST., ST. LOUIS, MO.
BOSTON ALBANY PHILADELPHIA CHICAGO DES MOINES OMAHA
KANSAS CITY OKLAHOMA CITY WACO BIRMINGHAM

The Purpose of This Book

CONCRETE has come to be the accepted material for construction which is meant to be permanent. It is used in the construction of great dams, tall skyscrapers and the most stupendous engineering works. The qualities which cause it to be chosen for such work make it equally desirable for the smallest structure on the farm or around the home. It has an added advantage in that it may be made by the owner himself with local materials or, in the case of larger structures, by any local builder.

Good concrete is obtained by using good materials and by the proper mixing and handling of the materials. To all appearances, it is a simple operation, but like many other apparently simple operations it requires a certain amount of skill. The quality of the concrete, therefore, depends to a considerable extent upon the experience of the maker or builder or upon the instructions he follows. It is the aim of this book to give reliable and simple instructions to the owner or builder.

In compiling this book information is given which will help you in the selection of good materials; the proportioning, the mixing, and the placing of concrete are all taken up in detail so as to make them simple and clear. One chapter is devoted to the special uses of concrete for improvements around the home, although much of the information on farm structures also applies to the home.

You may want further information about some particular feature of the structure, such details as the quantities of materials, amount of reinforcement or other points. In such event we hope you will write us or have your dealer write us. You are under no obligation for this service. The company furnishes this book and the information referred to above, without guaranty, warrant or other obligation on its part.

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Chapter 1—Why You Should Use Concrete

YOU are planning to build—a garage or a barn perhaps, a watering trough, feeding floor, hog pen, chicken house or root cellar. No matter what it is, there are certain questions that are bound to occur to you:

1. Can I do the job myself with my help right here on the farm? Or must I get special assistance from outside?
2. Can I use some of the materials I have right here on the farm? Or must I buy all my materials and perhaps wait for deliveries?
3. Is the job going to cost me much? Or can I keep the initial expense down fairly low?
4. Will it cost me a good deal for upkeep and repairs when done? Or can I count on practically no expense after first cost?

Whatever you build, these questions will come up. And the answer depends not so much on *what you are going to build* as on *what you are going to build it with*.

If you build of wood, you will have low first cost, but repairs and upkeep will be high and you will not have fireproof construction. Brick and building stone are both expensive and may be hard to get.

If, on the other hand, you build in concrete, these questions will be answered favorably. You may even be able to decrease your costs greatly by using sand and gravel or stone from your own farm. Therefore, with concrete in mind, let us take up each point to be considered.

1. Almost everything described in this book can be built *by you*, with ordinary farm help from the instructions in this book.
2. All the materials necessary for concrete construction can be procured almost anywhere: The cement you can get from your

local dealer. The sand and gravel or stone you probably can get right on your own farm or near by, at no cost except labor.

3. Concrete construction is economical. This is because many farm structures can be built by your own farm labor and often with sand and gravel found on your own land. In most cases concrete is little more costly than other less permanent materials.
4. Concrete costs almost nothing for upkeep, because it is waterproof, fireproof, rot-proof, rustproof, verminproof and, to a greater degree than anything else made by man, timeproof. *What you build with concrete you won't have to rebuild or repair.*

But don't think of just those four questions.

Think of building construction on the farm *as an investment*. You are *putting value into* the building whether you hire outside labor or expend your own efforts. And so you ought to consider *what you are going to get back*.

What are the dividends you get from your investment in concrete?

First, concrete construction means permanency. On many constructions you pay a yearly charge for permanency. You pay it in fire insurance and the cost of wear and tear or upkeep. Concrete construction, of course, is fireproof; it saves fire insurance by lessening the premium on both building and contents or by making it unnecessary for you to insure the building. Concrete does not wear out—there is no constant fixed charge each year for renewal, painting, etc.

Building in concrete is a precaution against sickness and death for your stock and against vermin and filth. You buy this insurance for a single initial payment. There are no annual payments afterward.

Concrete stable floors, concrete water tanks and concrete drains will suggest themselves to you as examples of conservation and increased value to your property. Farm sanitation in cow-barns and every other part of the farm is one of the great steps forward in modern hygiene, affecting not only the country but the whole nation, which now gets milk for its babies and grownups from cleaner, healthier dairy-farms than it did twenty years ago. And concrete more than any other building material has made this possible.

Looking at the whole matter from still another side, you will see that concrete construction actually *brings in money*.

If you have a sanitary cow-barn floor, you have cleaner milk and healthier cows—in other words, *more money*.

If you have a concrete silo, you preserve your silage better and more economically, and get more feeding value out of it. This is transmuted into beef, veal, milk, butter—in other words, *more money*.

If you build concrete manure pits, you can return to the soil practically all the strength of natural fertilizer, instead of letting 30 to 50 per cent of it wash away in heavy rains or dry up from too little moisture. That will mean that you will get bigger crops—in other words, *more money*.

If you have concrete drains in your fields, you increase their productivity, extend your season, check rain-washing or erosion, and assure yourself a bigger and better yield—in other words, *more money*.

What This Book Is About

What we have said so far has been to place before you the advantages of using concrete.

The next chapter will tell you what concrete is and how to make it.

Throughout this book we mention our *Technical Department*. By "our" we mean something that belongs to you as well as to the Atlas Portland Cement Company. By *Technical Department* we mean a group of men who are in our employ because they know how to use concrete to the best advantage. They are here to serve you, by giving you free advice and assistance on problems that come up on *your* farm. For help that you want and can't find in this book, write to The Atlas Technical Department.

The third chapter takes up the different jobs you can build of concrete and explains how to build them. Most of the structures are simply constructed and may be build with farm labor. The larger constructions, such as barns, silos, etc., where more experienced help is required, are only briefly described and the text advises you to consult a contractor for such jobs. Work that you may execute yourself is carefully explained and illustrated.

Chapter 4 tells you about concreting in cold weather. Concrete construction is possible all the year under certain conditions. This chapter tells what these conditions are and how it can be safely done.

Chapter 6 is on Atlas Portland Cement. Concrete, as explained in the previous paragraphs, is the wisest, safest, cheapest material for you to use in building on the farm. *Portland Cement* is the most important material used for making concrete. *Atlas Portland Cement* is the "standard by which all other makes are measured." So there is a good reason for your knowing about it if you are interested in any farm construction work.

We have made a list below of the various things which are of importance in using concrete. You will need to know a great deal about the first 6 subjects, whatever you build.

- I. Materials required and their selection

Cement	Stone or gravel
Sand	Water
 - II. Proportioning materials
 - III. Mixing concrete

Hand mixing	Machine mixing
-------------	----------------
 - IV. Placing, depositing and protecting concrete
 - V. Forms for concrete
 - VI. Surface finishing

Mortar facing	Rubbed or floated finish
---------------	--------------------------
- You may want to know something about Nos. VII to X—it depends on what you build.
- VII. Bonding
 - VIII. Waterproofing
 - IX. Reinforcing
 - X. Concrete in winter

Chapter 2—How to Make Concrete

I. Materials Required and Their Selection

1. Concrete is made up of three materials: (1) Portland cement, (2) sand, and (3) screened gravel or stone—mixed with water. (Portland cement and sand *alone*, mixed with water, form *mortar*.) Portland cement is a manufactured product, finely pulverized in form, which you can buy nearly anywhere in the world, in bags;

its purpose is to bind (or cement) together the particles of sand and stone. Sand and stone are found in abundance on most farms, or near by; they make up the bulk of the mixture that the Portland cement binds together, and in the building trades they are called “aggregates.” Sand is a *fine* aggregate. Stone is a *coarse* aggregate.

Portland Cement

2. You need not know all the technical details of the chemical composition and manufacture of Portland cement to use concrete. But you must know the few things that really affect its use in making concrete.

3. Portland cement comes from the mill in a very finely powdered or floury form. To be a good binding material, cement must have the property of hardening or “setting.” It does this when it comes in contact with water in any form. Therefore, in storing cement, be sure to keep it *absolutely* dry, away from any kind of moisture or dampness. *Don't leave it on the ground:* The ground is likely to have some moisture in it. When it has once been wet and becomes hardened, it cannot be used.

4. The weight of the cement itself in the bag, or of one bag upon another as it is piled in a car or storage shed, may make it hard or lumpy. Such lumps or hardening do not affect the quality of the cement or its power to set. They break up in mixing. To tell if a lump is due to this “pressure caking,” see if it will crumble when it is pinched between the fingers. If not, don't use it—its cementing value has been destroyed.

5. Once Portland cement begins to set, the operation of setting must be continuous and uninterrupted, or the result will not be thoroughly satisfactory. To secure what is called the proper curing of concrete, moisture must be supplied all the time it is taking its set, and all this time the mass of the concrete must not be disturbed.

Note.—It should be carefully noted here that “Portland” is not a brand name but is a descriptive term, used because the first Portland cement was about the same color as the famous limestone quarried on the Island of Portland. Today there are many brands of “Portland” cement manufactured in the United States. They vary just as different brands of flour or any other product vary. Therefore, you should always state the brand name first, insisting on *ATLAS* Portland Cement, instead of only asking for Portland Cement. Then you will be sure of high uniform quality and the best results. Cement is the most important ingredient in concrete. If your knowledge of concrete is limited, you should use a good, standard cement. Look for the brand name *ATLAS*.

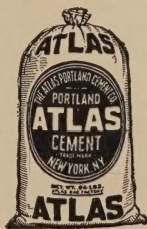


Figure 1—Atlas Portland Cement—“The standard by which all other makes are measured.” A bag contains approximately 1 cubic foot.

Aggregates for Concrete

6. Aggregate is the hard material—sand, gravel, stone, etc., that is mixed with Portland cement and water to make concrete. Aggregates are of two kinds—fine and coarse.

7. A *fine* aggregate is one the particles of which will pass through a screen with $\frac{1}{4}$ -inch openings. For fine aggregate the material commonly used is sand or fine quarry screenings of stone.

8. A *coarse* aggregate is one the particles of which will *not* go through a $\frac{1}{4}$ -inch screen and are usually not larger than $2\frac{1}{2}$ inches. Gravel or broken stone is the most common material for coarse aggregates. (In some localities, "gravel" denotes a mixture of sand and pebbles. In this book the word gravel refers to the pebbles over $\frac{1}{4}$ in. in size, after the sand has been removed by screening.)

9. Aggregates, fine and coarse, are *graded* by the average size of the particles, that is their diameter. This is most easily measured by testing with different size screens. Different grades

(or sizes) are used for different kinds of construction.

10. Getting the right sort of aggregate is going to be much more difficult for you than getting good cement, because Atlas Cement is carefully manufactured and thoroughly tested in order to make sure that it is uniform, but aggregates are untested raw materials. So you will have to test them yourself particularly if they are sand and gravel that you get from your own farm or from a nearby gravel pit, where they have not been properly screened and graded.

11. In choosing your aggregate, remember that a concrete cannot be harder than the aggregate of which it is made. If cinders or broken brick are used, the concrete will be porous and weak, like the aggregate. For strong concrete, use a firm, hard aggregate. For concrete work that is going to be exposed to the elements, avoid the use of any aggregate which is porous and will absorb moisture.

Sand (fine aggregate)

12. For concrete work, *sand* is defined as clean rock particles, free from loam, clay or other foreign substance, varying in size from fine to those that just barely pass through a screen with $\frac{1}{4}$ -inch meshes (4 meshes to linear inch; 16 meshes to square inch).

13. It is essential that the sand should be a mixture of fine and coarse particles—with more particles coarse than fine. There must be some finer particles because these smaller particles fit about and between the coarse particles, and fill in the empty spaces or voids between them. Figure 0 shows fine, coarse and graded sand in actual sizes. The graded sand in the center is best, because it contains both fine and coarse particles.

14. Good sand also *must be both hard and clean*.

15. The sand particles *must be hard*. The definition says "*rock*" particles. People also often say that sand for concrete must be "*sharp*," but that does not mean that the fragments need be angular. All that is necessary is that the particles be really *hard*.

16. The sand *must be "clean"*—free from foreign substances. Vegetable or animal impur-

ities, even in small quantities, may render the sand unfit to use in concrete. These impurities coat the sand particles so that the cement cannot stick to them and cannot bond as it should.

17. If you dig your sand from a bank, be careful to take off all the top soil first, and then there will be no chance of loam sliding into the pit and mingling with the sand. If you have any reason to doubt the cleanness of the sand, test it before using; otherwise, it may mean that all your labor and material will have been wasted.

18. **How to Test Sand.** To see if your sand is suitable for concrete, make tests from different parts of the bank. Often the sand in one part of the bank is good and other parts poor. From each part of the bank make up some concrete by mixing three measure fulls of sand and one of cement with the necessary water. Put this concrete in a tin pail and set aside for a week. Then break it and see if it is strong enough.

19. If the material does not harden there is some trouble with the sand. To test this secure from a drug store a 3% solution of sodium hydroxide (caustic soda). Place 4 inches of sand in a glass bottle and pour in the solution until



Figure 2—Photograph of a sample of well-graded sand. In the upper part of the illustration the sand is shown after it was separated by sieving into the various sizes of particles. In the lower part of the illustration the sand is shown before sieving. The particles range from very fine up to a maximum of $\frac{1}{4}$ inch in size. Width of respective strips indicates roughly the amounts of each size of particles. This is a good average sand for concrete work. Good concrete sand always should have a large proportion of coarse material.

it stands $7\frac{1}{2}$ inches high in the bottle. Shake thoroughly and leave over night. If the liquid is darker than a straw color look for another sand bank. If the liquid is clear or only slightly straw color, it is satisfactory. If there is more than $\frac{1}{4}$ inch of silt or very fine material, you can probably use the sand after washing it.

20. How to Wash Sand. Washing sand by wetting the pile with a hose is wrong—it only transfers the dirt to the lower part of the pile. The right way is for one man to shovel it on the upper end of a trough, like the one shown in Figure 3, while another man washes it down the incline by pouring water on it. There is a fine screen (size of mosquito netting) cleated to the incline. When the sand and water come to

this screen, the dirty water drains through and leaves the clean sand ready for use.

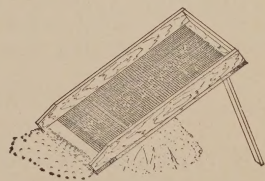
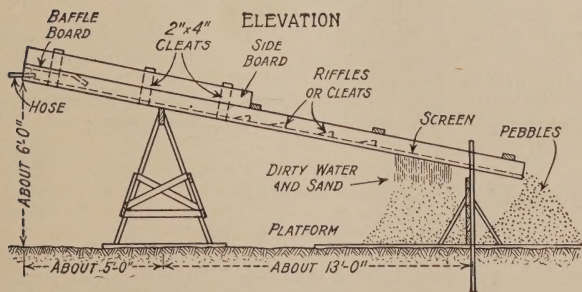


Figure 3—At left, simply made screen and washing trough for screening and washing sand at one operation. Where a great deal of sand is to be washed and screened it is customary to use a circular revolving steel screen. At right is a simple screen for screening sand. This has $\frac{1}{4}$ -inch meshes and may be used for separating pebbles from sand when using bank run sand. This is always advisable.



Figure 4—A well graded coarse aggregate. In this case the coarse aggregate is gravel, but the same principles apply to crushed stone. In the lower part of the illustration is shown the particles separated by sieving. At the left are the particles in size from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch, in the center $\frac{3}{8}$ inch to $\frac{3}{4}$ inch, and at the right $\frac{1}{4}$ inch to $\frac{3}{8}$ inch. In upper part of the illustration is shown the pebbles before screening. Notice how the small particles fit in between the large ones, thus producing a dense mixture.

Crushed Stone or Gravel (coarse aggregate)

21. To distinguish between fine aggregate (sand) and coarse aggregate (gravel or stone) we choose a certain size (one-quarter of an inch) and say that particles smaller than $\frac{1}{4}$ -inch are to be classed as fine aggregate, and particles larger than that are to be classed as coarse aggregate.

22. Coarse aggregate should be clean and free from impurities. It may be washed the same as the fine aggregate.

23. These coarse aggregates also should be graded, from fine to coarse, with coarse particles predominating. The coarse particles ought not to be more than $2\frac{1}{2}$ inches in diameter at the largest part, for ordinary construction.

24. Remember this: Don't use any pebble or piece of broken stone if its greatest dimension is more than one-half the thickness of the concrete you are placing.

25. Bank-Run Gravel. The usual, natural mixture of sand and pebbles as it comes from the ordinary gravel bank contains more or less foreign matter, and should be washed thoroughly before it is used.

26. Washing is easily done, especially if the gravel bank is right at the site of the work—see Figure 3. The sand and gravel are shoveled on the upper end of the platform and washed down the incline with water. The dirty water drains off through the screen and the clean material falls from the lower end of the platform.

27. Bank-run gravel usually contains such varying amounts of fine and coarse aggregates that it should be screened before using, separating the fine aggregate from the coarse aggregate and remixing in proper proportions—see Figure 3.

Summary of Directions for Choosing Aggregates

28. In choosing aggregates these rules are to be remembered.

1. All aggregates must be free from vegetable matter, dirt or other foreign substances.

2. To use bank-run gravel, separate the sand from the stone and pebbles by screening through a $\frac{1}{4}$ -inch screen.

3. For fence posts and other small concrete units the

fragments of coarse aggregate (crushed stone or gravel) should be $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. For larger construction the size may range from $\frac{1}{4}$ inch to $2\frac{1}{2}$ inches.

4. Sand must be coarse, hard and clean, with particles graded from fine to $\frac{1}{4}$ inch diameter, with the large size predominating.

5. The largest dimensions of the stones in the coarse aggregate should not be more than one-half the thickness of the wall or slab of concrete.

Water for Concrete

29. Use nothing but clean water. Scummy, dirty, muddy or alkaline water must not be used. A good drinking water is always right to use for mixing concrete. The amount of water to be used varies with the material used and results desired. See Mixing, page 12.

II. Proportioning the Materials

30. By "proportioning" we mean determining the necessary quantities of cement, sand and gravel or crushed stone, which you should use in doing your work. Cement is always the smallest quantity in a mixture for making concrete and is *always mentioned first*. It comes in bags containing approximately one cubic foot each, so the amount of cement is taken as the unit of measurement and the quantities of the other materials are compared with it. The *second figure* is always the number of parts of sand (fine aggregate). The *third figure* is the number of parts of stone or gravel (coarse aggregate). Thus, when we speak of a 1:2:4 mixture, we mean that to every cubic foot (bag) of cement there are two cubic feet of sand and four cubic feet of gravel or stone.

31. You can get satisfactory results only by proper proportioning.

32. The object of proportioning is to make a sufficiently dense concrete mixture. Sand or

gravel or crushed stone, alone, have between their particles empty spaces called "voids." To make dense concrete the cement, sand and stone must be proportioned so that the voids in the coarse aggregate are filled with the finer particles of sand and cement, and so that the voids in the sand are filled and bound together with particles of cement.

33. If you bear in mind what has been said about voids—that sand fills in voids in the stone, and that the cement fills in the voids between the grains of sand—then you will not make the common mistake of estimating that *one* cubic foot of cement, *two* cubic feet of sand and *four* cubic feet of stone will make seven cubic feet of concrete. Because so much of the material is used up filling voids, the actual total quantity of concrete obtained by mixing these quantities of aggregates is only a little more than the quantity of stone—four cubic feet—see Figure 5.

34. For almost all work about twice as much coarse aggregate (gravel or stone) should be used as fine aggregate (sand).

35. The following are typical mixtures:

Rich Mixture—1 part cement, 2 parts sand, 3 parts aggregates (used for concrete roads and waterproof structures).

Standard Mixture—1 part cement, 2 parts sand, 4 parts coarse aggregates (for reinforced work, floors, roofs, columns, arches, etc., and for tanks, sewers, conduits, etc.).

Medium Mixture—1 part cement, 2½ parts sand, 5 parts coarse aggregates (for foundations, walls, abutments, piers, etc.).

Lean Mixture—1 part cement, 3 parts sand, 6 parts coarse aggregates (for all mass concrete work, large foundations, backing for stone masonry, etc.).

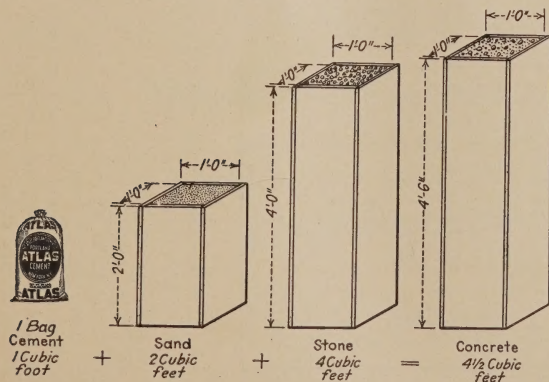


Figure 5—Volumes of three materials: cement, sand and stone, and the resulting volume of mixed concrete. The volume of mixed concrete is variable depending upon grading of stone and sand. It may be as much as 5 cubic feet.

Table for Determining Quantities of Materials Needed

36. The following table will enable you to figure the quantities of each material needed for any job, by adding together or multiplying the quantities in the table corresponding to the volumes in the first columns. The first column shows the quantity of concrete. The other five divisions show the different mixtures and quantities of materials under each mixture needed to produce quantity of concrete given in first section. Variations in sand and gravel may cause more or less material to be used. Therefore, it is best to have on hand more cement, sand and stone than actually estimated, so as to avoid delay from running short of materials.

Cubic feet of Concrete	1:1½:3 Mixture			1:2:3 Mixture			1:2:4 Mixture			1:2½:5 Mixture			1:3:6 Mixture		
	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone
100	28	42	8½	25 4/5	51 3/5	77 2/5	22	44	88	18	45	90	16	48	96
90	25 1/5	37 4/5	75 3/5	23 1/5	46 2/5	69 3/5	19 4/5	39 3/5	79 1/5	16 1/5	40 1/2	81	14 2/5	43 1/5	86 2/5
80	22 2/5	33 3/5	67 1/5	20 2/3	41 1/3	62	17 2/5	35 1/5	70 2/5	14 2/5	36	72	12 4/5	38 2/5	76 4/5
70	19 3/5	29 2/5	58 4/5	18	36	54	15 2/5	30 4/5	61 3/5	12 3/5	31 1/2	63	11 1/5	33 2/5	67 1/5
60	16 4/5	25 1/5	50 2/5	15 1/2	31	46 1/2	13 1/5	26 2/5	52 4/5	10 4/5	27	54	9 3/5	28 4/5	57 3/5
50	14	21	42	13	26	39	11	22	44	9	22 1/2	45	8	24	48
40	11 1/5	16 4/5	33 3/5	10 1/3	20 2/3	31	8 4/5	17 3/5	35 1/5	7 1/5	18	36	6 2/5	19 1/5	38 2/5
30	8 2/5	12 3/5	25 1/5	7 3/4	15 1/2	23 1/4	6 3/5	13 1/5	26 2/5	5 2/5	13 1/2	27	4 4/5	14 2/5	28 4/5
20	5 3/5	8 2/5	16 4/5	5 1/5	10 2/5	15 3/5	4 2/5	8 4/5	17 3/5	3 3/5	9	18	3 1/5	9 3/5	19 1/5
10	2 4/5	4 1/5	8 2/5	2 3/5	5 1/5	7 4/5	2 1/5	4 2/5	8 4/5	1 4/5	4 1/2	9	1 3/5	4 4/5	9 3/5
9	2 1/2	3 4/5	7 3/5	2 1/3	4 2/3	7	2	4	8	1 3/5	4	8	1 1/2	4 1/3	8 2/3
8	2 1/4	3 3/8	6 3/4	2	4 1/6	6 1/4	1 3/4	3 1/2	7	1 2/5	3 3/5	7 1/5	1 1/4	3 7/8	7 3/4
7	2	3	6	1 4/5	3 1/2	5 2/5	1 1/2	3	6	1 1/4	3 1/8	6 1/4	1 1/8	3 3/8	6 3/4
6	1 2/3	2 1/2	5	1 3/5	3 1/5	4 3/5	1 1/3	2 2/3	5 1/3	1 1/10	2 3/4	5 1/2	1	3	6
5	1 2/5	2 1/10	4 1/5	1 1/3	2 2/3	4	1 1/10	2 1/5	4 2/5	9/10	2 1/4	4 1/2	4/5	2 2/5	4 4/5
4	1 1/8	1 3/4	3 3/8	1	2	3 1/5	7/8	1 3/4	3 1/2	7/10	1 4/5	3 3/5	5/8	2	4
3	4/5	1 1/4	2 1/2	3/4	1 1/2	2 1/3	2/3	1 1/3	2 2/3	1/2	1 1/3	2 2/3	1/2	1 1/2	3
2	9/16	7/8	1 11/16	1/2	1	1 1/2	7/16	7/8	1 3/4	1/3	9/10	1 4/5	5/16	1	2
1	9/32	7/16	7/8	1/4	1/2	3/4	7/32	7/16	7/8	1/5	1/20	1	5/32	1/2	1

you will need 64 bags cement, 128 cubic feet sand and 256 cubic feet stone or gravel.

37. Example: If you want to know materials for 291 cubic feet of 1:2:4 mixture, look in the columns headed "1:2:4 mixture," copy out the figures for 100 cubic feet and multiply them by two, to make 200. You will have 44 bags cement, 88 cubic feet of sand and 176 of stone. Then look under the same head, opposite 90 cubic feet: 19 4/5 bags cement, 39 3/5 cubic feet sand and 79 1/5 cubic feet stone. Then look opposite 1 cubic foot and you find 7/32 bag cement, 7/16 cubic foot sand and 7/8 cubic foot stone or gravel. Add these three and you find that for 291 cubic feet of concrete in 1:2:4 mixture,

38. To figure out how many cubic feet of concrete there are in your job, write down the dimensions all in feet or fractions of feet so that your result will be in cubic feet. To find the cubic feet in a pavement 30 feet long, 4 feet wide and 4 inches thick, write the last dimension as feet (like the others) calling it 4/12 or 1/3 foot. Then multiply 30 by 4 by 1/3 and the answer will be 40 cubic feet. Look in the table under the mixture that you are going to use—opposite 40. Take the quantities there for your job.

39. For a wall or a slab or a roof, you will find it easy to calculate the total cubic feet of concrete if you will just remember that you must multiply together the three different dimensions—all expressed in feet or fractions of feet.

40. For more difficult buildings, take each part by itself—floor, wall, roof or whatever it is.

41. For complicated jobs, be careful not to count corners twice—on walls for instance. If you are building a trough, 12 feet long, 6 feet wide, walls 6 inches thick and 48 inches high, the two long walls will be 12 feet long, 4 feet high and 6 inches thick, but the other two walls will be only 5 feet long, 4 feet high and 6 inches thick—because the 6-inch thickness comes off the end of each of the short walls at each end.

42. If you are building a square tank or a room or anything hollow for which the proportioning of materials is the same in all its parts figure on the whole thing as if it were solid and then subtract the cubic contents of the hollow part in the center. For instance, you could find out the number of cubic feet of concrete needed for a tank 10 feet long and 10 feet wide and 8 feet high with walls, floor and roof all 6 inches thick, by calculating first the contents of the whole thing as if it were solid. That would be 10 times 10 times 8, or 800 cubic feet. Then figure the contents of the hollow inside. Allowing for the 6-inch walls, the inside measurements will be 9 feet long, 9 feet wide and 7 feet high. So the contents of the hollow part will be 9 times 9 times 7, or 567 cubic feet. The number of cubic feet in the walls, floor and roof will be the

difference between 800 and 567, or 233 cubic feet.

43. To calculate for anything circular there is one rule to remember: the area of a circle is found by multiplying the diameter by the diameter, then multiplying the result by $3\frac{1}{7}$ and dividing by 4. So that a circular slab of concrete 7 feet in diameter would have an area 7 times 7 times $3\frac{1}{7}$, divided by 4—that is $38\frac{1}{2}$ square feet. Multiply this area by the thickness in feet or fraction of a foot, and you have the number of cubic feet in the slab. If this slab is 6 inches thick, the number of cubic feet in it will be $38\frac{1}{2}$ multiplied by $\frac{1}{2}$ —or $19\frac{1}{4}$.

44. If you are building a circular tank, figure the total contents as if it were solid right through. Then calculate the contents of the hollow space that is *not* to be filled with concrete and subtract this from the first total.

Note.—The mortar and concrete tables below give the cubic foot quantities of mortar and concrete respectively resulting from each of the mixtures shown.

When making calculations on the amounts of materials needed, you must bear in mind that it is not possible always to come out exactly right in figuring the quantities. You may use a little more or a little less than you figured and this is because sand and gravel or stone varies greatly and may use up more or less cement than average. It is always best to have on hand more cement, sand and stone than actually figured on—then you won't run short when the job is almost completed. A few bags of cement kept in a dry place can be used within the next few months for doing many an odd job to improve your property.

Amounts of Mortar and Concrete—Various Mixtures

Mortar

Mixture		Volume of Mortar
Cement	Sand	
1 bag	2 cubic feet	make 2 $\frac{1}{10}$ cubic feet
1 "	2 $\frac{1}{2}$ " "	" 2 $\frac{1}{2}$ " "
1 "	3 " "	" 2 $\frac{4}{5}$ " "

Concrete

Mixture			Volume of Concrete
Cement	Sand	Gravel or Stone	
1 bag	1 $\frac{1}{2}$ cubic feet	3 cubic feet	make 3 $\frac{1}{2}$ cubic feet
1 "	2 " "	3 " "	" 3 $\frac{9}{10}$ " "
1 "	2 " "	4 " "	" 4 $\frac{1}{2}$ " "
1 "	2 $\frac{1}{2}$ " "	5 " "	" 5 $\frac{2}{5}$ " "
1 "	3 " "	5 " "	" 5 $\frac{4}{5}$ " "

III. Mixing Concrete

45. Concrete should be mixed near the place where it is used, because it begins to "set" almost as soon as you have mixed it. Mixing can be done either by hand or machine.

46. When you mix the concrete for the first batch, determine just how much water produces the required consistency and then use the same quantity, carefully measured, for other batches of the same size for the same job. Try to get a "quaky" or jelly-like consistence. A mixture of this consistency can be made to settle into place evenly.

47. If too much water is used the mixture will be thin, sloppy or soupy—instead of jelly-like—and the concrete will not be as strong as when less mixing water is used. Use only enough water to produce a quaky consistency.

48. The three grades of consistency used are:

1. **Mushy or wet consistency**—not to be used except for very thin walls or sections. (Will not give maximum strength.)

2. **Quaking consistency**—quaky or jelly-like. The best consistency to use for ordinary work.

3. **Dry consistency**—like damp earth. This consistency must be thoroughly tamped or packed when deposited. Used in making concrete block.



Figure 6—Three grades of consistency. At top: Dry consistency. Center: Quaking consistency. Bottom: Mushy or wet consistency.

Hand Mixing*

49. A satisfactory platform can be made for mixing ordinary quantities of cement by laying boards together on the ground. It will be better to have the ground smooth underneath so that the boards will fit close together. When you just lay boards down on the ground this way, you will lose some cement in the first batch you mix, but after that the loss will be very small. If you want a permanent platform, you can nail it together, using inch boards placed on 2-by-4-inch stringers spaced 2 feet apart, making the platform as tight as possible. If you want to make a really watertight platform, use two layers of boards, laying one layer crossways of the other. If the boards are smooth on top, shoveling and turning will be easier.

50. In doing the actual mixing, you will find the following method most satisfactory:

A. Measure all materials accurately to get correct proportions. Make a measuring box to hold a cubic

foot—a bottomless box measuring one foot each way (inside measurement). Put handles on the side, so that you can raise the box easily.

B. Wheel the sand to the mixing board, measure it and spread it about 4 inches deep on the board.

C. Empty on the sand the correct amount of cement, according to the mixture desired—see Proportioning on page 9. Spread the cement evenly over the sand.

D. Turn dry sand and cement over and over with a shovel or hoe until they are thoroughly mixed.

E. Spread out the mixture and empty on it the proper amount of coarse aggregate carefully measured. Mix this thoroughly.

F. Add three-quarters of the required amount of water—say, about three-quarters of a gallon to each cubic foot of concrete. Be careful to add the water slowly and evenly, mixing the whole mass at the same time.

G. Add more water wherever dry spots appear, until the whole mass has been turned or shoveled over three or four times.

H. Then shovel the mixture into a compact mass and wheel away.

*Hand mixing is being replaced by machine mixing on all but the very smallest jobs. Inexpensive machine mixers in very small sizes are on the market. Write us for names of manufacturers.

Machine Mixing

51. Mixing by machinery is more economical than doing it by hand on large jobs. It will be an actual saving for you to buy or hire a small mixer if you are planning to do any great amount of concrete construction.

There are many types of power-operated concrete mixers on the market—small ones with gasoline engines and large, self-propelling machines. Don't think of buying anything but

a batch mixer, that is, one with a revolving drum in which all the materials are put together and which revolves until the mixing is completed. You must be careful to leave the material in the drum long enough to assure thorough mixing—at least one minute after all the materials are in the drum. It is just as important to be careful and accurate about the amount of water in machine mixing as in hand mixing.

IV. Placing and Depositing of Concrete

52. After the concrete has been mixed, it is in plastic form and must be placed in forms or moulds to shape it in the required form. The construction of forms for concrete is explained later in this book.

53. Concrete must be placed as soon as it is thoroughly mixed—at the longest, within 30 minutes.

54. Methods of placing concrete vary with working conditions and the nature of the construction, but the following fundamental rules apply to all ordinary types of construction:

A. For mass foundations, pavements and similar work not having reinforcing, the mixture can be of a consistency between that of "quaking" and "dry" shown in Figure 6. It is often convenient to pack this semi-dry concrete in place with a tamper or rammer; continuing the tamping action until mortar shows on top of the concrete and covers all stones.

B. For concrete walls and piers of some height, but not containing reinforcing, the mixture can be made of "quaking" consistency. While the concrete is being deposited it should be spaded or churned by means of a spading tool or sharpened piece of 1 inch board. The board should be 1 inch by 4 inches, sharpened to a chisel edge at one end. Keep the flat side of the board next to the form and the sharpened side turned in. The spading action should be especially thorough next to the form as this thrusts back the stones and allows the mortar to flow against the forms and give a smooth surface. Concrete should be deposited in layers from 6 to 12 inches deep and as uniformly as possible so as

to bring the concrete up at the same level at all points.

C. For thin walls, slabs and beams, containing much reinforcing the "quaking" consistency should be used, but no more mixing water should be used than is absolutely necessary for the purpose of making the concrete work well around the reinforcing. In addition to the spading described in the previous paragraph, it is well to churn the concrete around the reinforcing with a piece of steel reinforcing rod and to pound the forms well with wooden mallets at the point where the fresh concrete is being deposited.

D. It is desirable in most work, and an absolute necessity in work where watertightness is a consideration, that you deposit the concrete quickly enough so that each layer remains in place less than half an hour before being covered with the next layer. In this way each layer will be sufficiently soft so that the next layer will mix with it and thus avoid the formation of joints. If possible, it is best to complete the depositing of concrete for tanks, troughs, cisterns and reservoirs without stopping, thus avoiding joints and seams which might leak. If it is impossible to complete the pouring in one continuous operation the joints should be made in the following manner: Allow the last concrete deposited to set for an hour or two and then, before it begins to harden fully, remove the top inch or so with a wire brush or very stiff fibre brush. Be sure to get the surface of the concrete level and absolutely clean and free of all scum and loose matter. Before the concreting is resumed, again scrub the surface, this time using plenty of clear water so that the concrete will be clean and well saturated, but without free water standing on it. Then, just before depositing fresh concrete, paint the old surface with a thick cream of cement and water. Sometimes it is well to omit the coarse aggregate, or a portion of it, from the first batch deposited so as to avoid stone pockets at the joint.

Protection of Concrete

55. Concrete hardens by forming a chemical compound with the water mixed in it. This action goes on for at least several weeks. Therefore, in concrete placed in thin layers or sections it is necessary to prevent the wind and sun from evaporating the water out of the concrete before the cement has had a chance to use it.

In foundations for buildings, few precautions need be taken, but in making feeding floors,

watering troughs, and other small work, the concrete should be protected from the drying out action. Level surfaces such as walks, floors, etc., can easily be protected by sprinkling and covering with a layer of earth or hay kept wet.

Cover other small structures that cannot be protected with wet earth, with old bags and keep them wet. Proper protection means a great difference in the strength of the concrete.

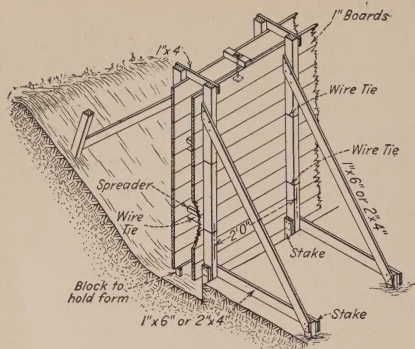


Figure 8—Forms for foundation to be erected in soft earth, showing necessity for inner and outer form. Notice method of supporting form so as to provide for a spread footing underneath the bottom of the wall.

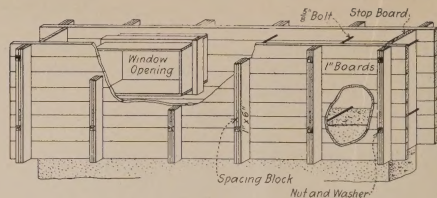


Figure 7—Sectional form for wall which is raised as the concreting progresses, and used over and over. Notice the method of inserting form for window opening.

Figure 9—Sectional form for casting wall in sections. Notice method for making dovetail between wall sections.

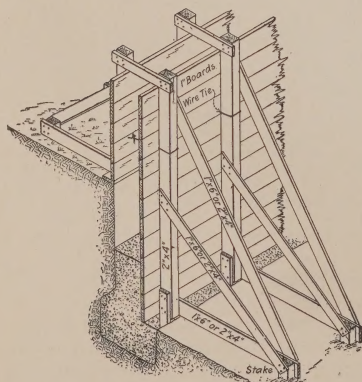
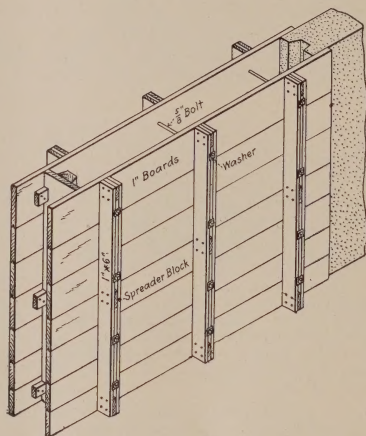


Figure 10—Form for foundation wall to be constructed in solid earth which will stand firmly in a vertical position. No outside form is used the earth acting as a form.

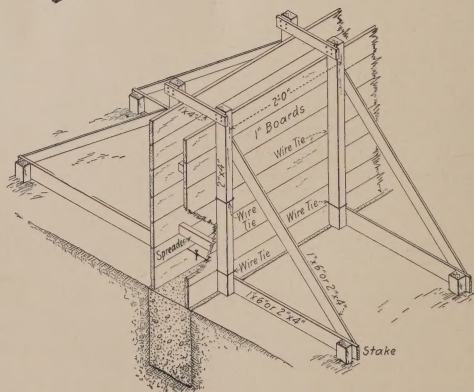


Figure 11—Wall form for small structure such as garage where foundation wall is poured in trench dug in the ground.

V. Forms for Concrete—General Information

56. Before it hardens, concrete will take the shape of anything it is poured into. The forms that shape the concrete have to be strongly made because wet concrete is very heavy.

57. Forms are best made of any of the soft woods as they do not warp so easily when wet. Either green or seasoned lumber can be used. Planed lumber is more easily cleaned and the concrete does not stick to it so readily. If it is possible, use lumber that is dressed or planed on both sides and edges and make the forms as tight as possible.

58. For even more particular work or where

the forms are to be used several times, use tongue and grooved boards, or beveled boards, as you will get a much smoother finish.

59. If forms are to be used only once the concrete can be kept from sticking to them by thoroughly wetting them before the concrete is poured. If the forms are to be used several times or particularly careful work is being done, the forms should be greased. For this, soft soap, crude oil or any heavy mineral oil can be used.

60. Be sure to get forms absolutely vertical—especially forms for walls or piers. Use a spirit level or a plumb bob.

How Long Should Forms Be Left In Place?

61. The length of time you will need to leave forms in place depends on what you are building.

62. For small construction work where the concrete bears no weight, the forms may be removed as soon as the concrete will bear its own weight—that is, some time between 12 and 48 hours after the concrete has been placed.

63. Where the concrete must resist the pressure of the earth or water—as in retaining walls or dams—the forms should be left in place until the concrete has developed nearly its final strength (this may be as long as three or four weeks, if the weather is cold, or anything else prevents quick curing).

Foundation and Wall Forms

64. No forms are needed for small foundations if the soil is firm. Simply dig a trench the exact size, and fill the trench with the concrete, being careful not to knock earth from sides into the fresh concrete.

65. Figure 10 shows the construction of a form for a foundation wall where the soil is firm enough to act as a form for one side of the wall. The wooden form, for the other side of the wall, is held up on stakes to permit the concrete to run out a little under the form and make a footing or broader base for the wall. It is often more economical to provide an outside form even if the soil is firm, because a considerable amount of hand work is required to cut the sides of excavation exactly vertical and true to line.

66. For walls above ground, forms are required on both sides. The heavy concrete is likely to bulge these forms or force them apart. Therefore, the forms should be braced strongly against the ground; or the two sides of the form may be held together by wires or bolts; or better yet, as it prevents bulging or spreading and

keeps the two forms exactly the right distance apart, the braces and the bolts (or wires) are used together.

67. Figure 11 shows the method of bracing wall forms built on a footing already in place. Wires around the studding hold the forms together, and can be tightened to make the distance between the forms the exact thickness of the wall. Pieces of wood, called spreaders, each cut to a length equalling the thickness of the wall, are inserted to keep the walls the right width. They are knocked out and removed as the concrete is poured.

68. Figure 8 shows foundation wall forms for both sides. The one next to the earth is supported on small blocks so that the concrete can flow out and make a broader base or footing. The inside form rests on stakes. This diagram shows how bolts can be placed in the top of the wall to fasten sills to the foundation.

69. Figure 7 shows forms for walls that can be used over again several times. Slotted up-rights are made of boards 1 inch thick and 6

inches wide, separated by small blocks. Through these uprights, to hold the forms together, there are bolts, which must be thoroughly greased so they can be removed easily from the concrete. The same type of form is used for walls built in successive layers.

70. A long wall is most easily built in sections, the same form being used several times. As soon as the first section has had time to set, the forms

can be moved along and the next section poured. One end of the forms fits over the concrete already in place. The other end is closed by a vertical board with a wedge-shaped block on the inside (see Figure 9) to make a recess at the end of one section so that the new concrete of the next section will make a tight joint with the old concrete of this section and key in with it.

Forms for Piers and Columns

71. Forms for columns and posts which are filled with concrete in an upright position are subject to much greater pressure near the lower part. They must, therefore, be built stronger at the bottom than at the top. The easiest way to do this is to put the yokes or clamps closer together near the bottom of the form. For column forms the boards should be placed vertically; they should be tongued and grooved so that the pressure of the concrete will not force water and cement between the boards.

A clean-out panel should be provided near the bottom of forms for tall piers and columns. This consists of a few sections of board which can be removed so that chips, shavings and other debris can be swept out just before depositing the concrete. When filling tall column forms it is best to make the first batch cement and sand alone, or else only use half as much gravel or stone as would be normally used. Also, when the form is filled to the top, let the concrete settle for an hour or so before concreting any roof beams or slabs which may join on to the top of the column.

72. A form having inside measurements of 10 or 12 inches on each side of the top and a little more at the bottom — being

sloped so that it can be lifted off the concrete, is a very useful form to make and keep around. With such a form you can do a great deal of work at odd times, when you need two or three piers, or even more, to use as a foundation for some building. The top level of the pier can be regulated by putting blocks under handles of the form. By digging the hole for the base of the pier about 6 to 8 inches bigger each way than the form, you will get a very substantial footing under the pier which should give ample support in ground of average hardness. When the soil is very hard the form is not necessary below ground level.

73. For short columns or piers less than 5 feet high and not over 2 feet square, make the forms as shown in Figure 12 at the left.

74. Larger, heavier columns, because of the great weight of the concrete on the bottom, must have heavier forms, as shown in Figure 12. These heavier forms have yokes of 4-inch-by-4-inch material, held together by bolts, and side pieces held in position by wedges.

75. Where you build a column which carries no weight, you can usually take the forms off within 24 to 48 hours.

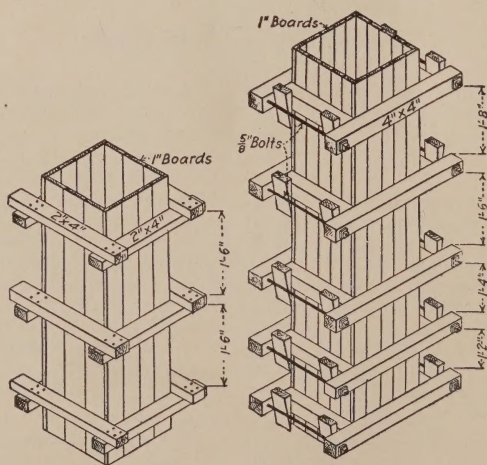


Figure 12—Forms for piers and columns. At the left, form for short pier. At the right, form for a taller column, which must be built strong because of pressure of fresh concrete in tall columns.

Forms for Concrete Roofs

76. Figure 13 shows forms for roofs, consisting of upright posts, each 4 inches square and not more than 4 feet apart, supporting 4-inch-by-6-inch crosspieces, which carry 2-by-4-inch or 3-by-4-inch stringers spaced not more than 2 feet apart. These stringers hold the 1-inch sheathing boards, running in the same direction as the crosspieces.

77. Forms for roofs should not be removed in less than three weeks' time. If the weather is cold you will find it better to leave the forms even longer than three weeks. It is very important that roofs have plenty of time to set before they are used.

When roof-forms must be used over and over, time can be saved by stripping the forms after a few days or one week, and immediately replacing the upright posts, wedged in place to support the roof slab until it has gained full strength.

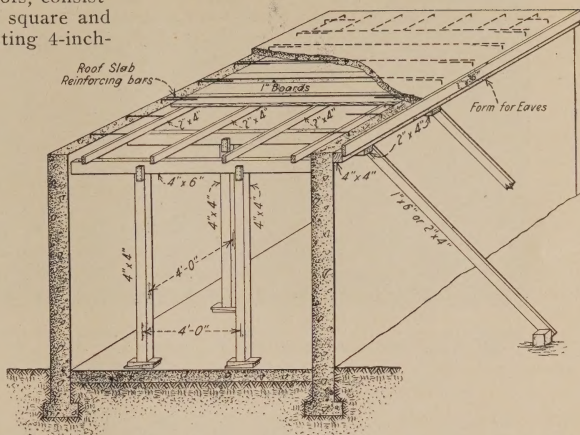


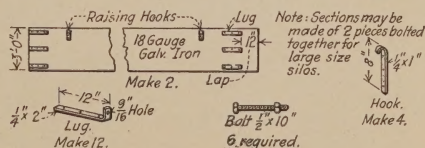
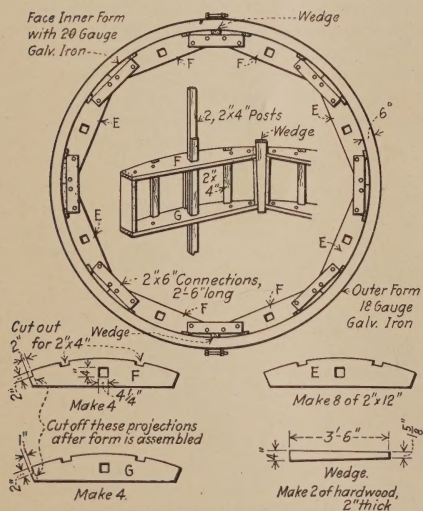
Figure 13—Form for reinforced concrete roof construction. Notice principal reinforcing bars extending across the short span of the roof. It is customary to also use bars extending at right angles to these. The short lengths of bars extending into the walls are called "dowel" bars and are for the purpose of anchoring the roof slab to the walls.

Forms for Circular Tanks, Silos, Etc.

78. Circular forms—one for the outside and one for the inner wall—are built as shown in Figure 14.

79. Work on a level piece of ground or on the barn floor. Make a "compass-stick" of a light piece of wood which is a little longer than *one-half* the distance across the circular construction you plan. Bore holes in either end, so that the distance between the two is exactly one-half the diameter of the circle you plan. Through one of these holes drive a nail, through the other insert a lead pencil. Carrying the stick around with the pencil in place will mark the circle for the outer form. Then bore another hole for the pencil at a distance from the first the same as the thickness of the concrete to be—and using this in the same way you have the outline for the inside form.

80. Following these outlines, shape with a saw the parts of the forms shown in Figure 14.



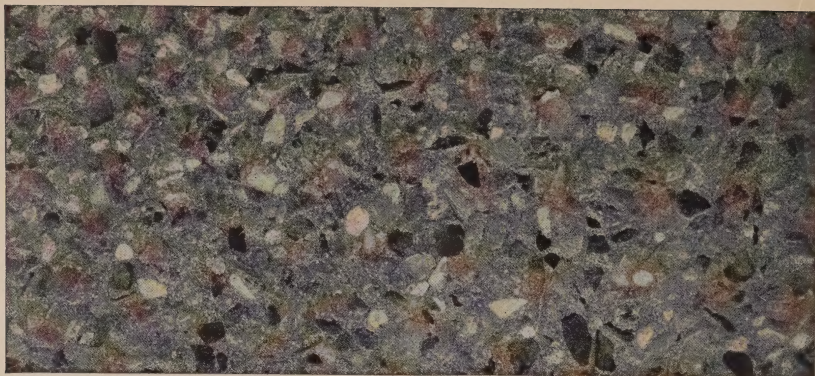


Figure 15—An example of special surface finish secured by washing concrete with a solution of 1 part commercial muriatic acid and 4 parts water. After solution has acted, it is rinsed off with clear water.

VI. Surface Finish for Concrete

82. No special finish is necessary for most concrete construction, especially if proper care has been taken in all the steps and processes up to the point of finishing.

83. If the surface is to be exposed and you want it to present an attractive appearance, the concrete must be composed of good sound aggregate, very carefully mixed and quite as carefully deposited. Besides, the forms should be well constructed, for any slight imperfection or irregularity of the forms will shape itself into the molded concrete. Thorough spading of the concrete as soon as it is placed prevents voids or pockets of rough aggregate on the outside surface. By "spading" is meant working a spading-tool (Fig. 15a) back and forth and up and down between the concrete and the form on the side where the finished concrete will be exposed to view. This brings the mortar to the front next the form, as described in paragraph 54b on page 13.

84. Observe carefully the following for concrete having exposed surface:

- Careful selection of aggregates.
- Accurate proportioning and thorough mixing.
- Care in depositing in place.
- Well constructed forms.
- Spading the concrete.

But no matter how well you construct your forms and spade the mixture, the concrete will show board marks. These are not always removed, but it is easy to get rid of them, if desired, by rubbing the surface, as explained in the next paragraph.

85. Rubbed or floated finish. As soon as the forms are removed, rub the concrete with a cement mortar brick (a brick made of 1 part of cement and 4 parts of sand) or with a carborundum block. Keep the surface thoroughly flushed with water and rub it until the pores and any slight roughness of the surface are eradicated and the color is uniform throughout. This is a simple, quick method of finishing and it gives a permanent, satisfactory surface.

86. Mortar finish. Facing concrete with a coat of mortar plaster is often a troublesome undertaking because it is difficult to obtain a satisfactory bond—that is, a strong enough cohesion—between the concrete mass and the surfacing mortar. (For bonding surface mortar coats, see next page.) The mortar should be applied in as thin a layer as possible. The proper proportions are 1 part Portland cement and 2 parts sand.

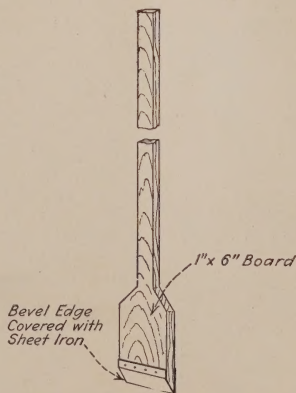


Figure 15a—A spading tool which can be easily made in case a manufactured tool is not available. The sharp edge of the tool is kept next to the form in the spading operation.

VII. Bonding Mortar or Concrete to Concrete Already Set

87. Bonding concrete surfaces—that is getting them to bind together well, making the bond between them strong—must be very carefully done on any sort of job. Getting newly mixed or green concrete to bond with concrete that has already set is often very difficult—but it can be done, if you take the proper precautions in preparing the old concrete surface.

88. If you wish to place more concrete or a mortar facing on any previously set concrete surface, you must first remove from the surface the whitish film or layer which has no strength itself and to which fresh concrete will not adhere. This forms on all concrete surfaces which are exposed. It is made up of fine particles of cement, sand, and foreign matter, all brought to the surface by the water in the mixture.

89. One way to remove this film is to take away the forms as soon as the concrete can bear its own weight, and then brush the surface off with a wire brush. If the concrete has set hard before the forms are removed, the surface film cannot be removed unless the surface is roughened by stone picks or a cold chisel. Whatever the method of removing the surface, the aggregate of the concrete must be exposed, or the newly deposited concrete or mortar will not bond to the old.

For important work where special care is to be given to securing a good bond, the treatment just described may be followed with an acid wash to clean the roughened surfaces. Slowly add 1 part of commercial muriatic acid to 4 parts

of water. Scrub surfaces with mixture, using a fibre brush. (Wear rubber gloves while doing this.) When action of acid has ceased, rinse off with plenty of clean water.

90. Mortar facing or surfacing. If you are placing a mortar facing or surfacing on a concrete surface, drench the wall thoroughly with water not more than 30 minutes before the application of the mortar, and brush the surface with a thin cream made of cement and water. This cream should be mixed in small batches as the work progresses and should be used within 30 minutes after it has been mixed, because it loses its strength after that time.

91. Trowel the mortar facing on the surface after this preparation, and press the mortar firmly to a smooth uniform surface.

92. Sprinkle the mortar surface with water *twice* a day for about ten days. This is a positively *necessary* precaution, because facing cannot develop its full strength unless it has moisture supplied continuously throughout the time it is hardening. If drying is too rapid, there will be excessive shrinkage and the surface will check and show hair cracks.

93. Whenever it is possible, apply the mortar surfacing or wearing surface—as in sidewalks, floors, etc.—at the same time as the base or main mass of concrete. This gives far more satisfactory results and makes a perfectly solid mass—like one huge stone—in which there are no difficulties of bonding.

VIII. Waterproofing Concrete

94. Concrete made from properly selected aggregates, combined with Atlas Cement in proper proportions, thoroughly mixed to the proper consistency, carefully placed, and well protected until it has had an opportunity to set, will be watertight under all ordinary conditions.

95. Investigations of the U. S. Government Bureau of Standards at Washington show that the use of waterproofing compounds, now on the market, will not make up for lean mixtures, poor materials, or poor workmanship, and that

if the same care is taken in mixing, without these compounds, as is usually taken when the compounds are used, the resulting concrete will be waterproof under all ordinary conditions.

96. If you have trouble with concrete already placed which is not watertight, the reason is probably careless workmanship or poor design. Write to our Technical Department thoroughly describing the work. We will be glad to advise you what is the proper method to overcome the difficulty.

IX. Reinforcing Concrete

97. When concrete is properly made it has the strength and characteristics of stone. Like stone, it will support heavy loads—as in foundations or in flat work resting directly on the ground, such as sidewalks; but concrete, like stone, will not stand much pulling apart or tension.

98. But when concrete is reinforced with steel rods, wire strands, or wire mesh embedded in it at the time of pouring, it has added strength, for the steel withstands the pulling apart or tension. Steel and concrete expand and contract almost exactly the same amount with changes in temperature. Hence steel reinforcing, when embedded in concrete during the pouring, acts as a unit with the concrete. The steel resists the pulling apart, while the concrete resists the compression or pushing together. In this way the two materials, in the form of *reinforced concrete*, afford the ultimate in strength and economy.

99. Where to put reinforcing, how much to use, and when it needs to be used, are all questions that involve highly technical points which need not be explained here in detail. The practical information that you need for each piece of construction you undertake will be given in this book in the next chapter under the section that describes the particular construction.

100. In most small work, such as sidewalks and cellar floors, reinforcement is not necessary. Reinforcement is needed in roofs or floor spans which are supported by walls or columns, in high walls, pillars and all kinds of posts. We are giving in another part of this book (see page 68) complete information on fence posts, and by following the instructions there you should have no difficulty in making satisfactory reinforced posts. For other work requiring reinforcing, except in very simple cases, you will probably find it safer and wiser to have a contractor or engineer advise you about reinforcing. The instructions for reinforcing which are given in the description of various kinds of construction in Chapter 3, should be followed very carefully, for it is very important to have reinforcing in exactly the right place and completely surrounded by the concrete.

Note.—Should the instructions regarding reinforcing not be entirely clear or should you want information on a size or kind of structure not included herein, write our Technical Department, describing just what you want to build, the size you are planning, etc.—give us all the data you can, better too much than too little, so we can understand just what your problem is. We have experts who are thoroughly versed in the reinforcing of concrete, and they answer thousands of such questions every year. This service is free, of course.

X. Concreting in Winter

101. If you have some indoor concrete work to do, such as cellar floors, barn floors under cover, etc., you can do it successfully in winter time if you take proper precautions to keep the concrete from freezing.

102. You can make fence posts blocks, etc., indoors in the winter time very successfully, but outdoor work in concrete is not advisable after the temperature gets below 45 degrees. If you have to do some outside concrete work in cold

weather, you must keep the concrete from freezing by heating the aggregates, using warm water, and properly covering the concrete until it gets so far along in setting that it will not freeze.

103. Chapter IV, pages 87 to 89, inclusive, treats this subject more in detail. If you have a special problem concerning the use of concrete in cold weather, we invite you to write to our Technical Department.

Chapter 3—What You Can Build in Concrete

Foundations for Large and Small Buildings

Foundations, to be satisfactory, must be strong, durable, and reasonable in cost. Concrete does not deteriorate but grows stronger with age. In every respect it is ideal material for foundations.

Either solid concrete or concrete blocks may be used. In most cases, solid concrete is preferable because it is entirely in one piece, without joints, and is stronger. Where there is a possibility of ground water, solid concrete is far better because it is more watertight.

Laying Out Foundation

Foundations may be laid out in two ways. Small buildings, say not more than 15 feet square, can have the corners squared sufficiently accurately using a carpenter's square, as shown in the lower left hand corner of Figure 16.

For larger buildings, greater care must be taken to get the corners square. This is done by making a larger square out of scantlings and using it on the corners. Make it as follows:

Take three sticks of straight scantling planed on both sides and edges. Then nail them together as shown in the lower left hand corner of Fig. 16. If you get the inside dimensions of the triangle just 6 ft., 8 ft. and 10 ft., it will make a perfect right angle. Use this for getting the corners square. Then check by measuring

the diagonals of the building and see that they are the same.

This will give you a big and correct right angle or square. Always check the work by measuring diagonally across the corners after they are set, the diagonals should be the same.

After these stakes are set, erect batter boards as shown in Fig. 16. Have the tops of these all at the same height or level by setting with a surveyor's level or builder's level. Stretch strings across them so that where the strings cross is directly over the corner stakes. Then, when the excavation is made and the original corner stakes are lost, you will have corners to work from.

How to Build in Concrete

Forms: The construction of forms for foundations is described on page 15, paragraphs 64-70.

For ordinary trench walls, where there is good solid ground, you need build forms above ground only; and you can make the trench just the width of the wall desired. Put 2-by-10-inch planks flat on the ground along the edge to prevent the earth from being broken off and knocked into the excavation. Hang tarred paper or burlap on the side opposite that from which the concrete is dumped, so as to protect that side against crumbling by the concrete. Just before pouring the concrete, wet the earth to make it firmer.

For cellar or basement walls, if the ground is solid and firm, you need build forms for the inside only. If the ground is not sufficiently solid, then build forms for

both sides, as described on page 15; see Fig. 8, page 14.

If your building is to have a frame superstructure with wooden floor, the foundation forms should be carried higher than the ground level, to provide for a floor a little distance above the ground. Build the forms of stock length lumber in sections, so that they can be used over and over again. Be sure that the concrete is sufficiently hard and strong before you remove the forms—see paragraphs 62-63, page 15. Do not fill in earth outside the walls for about 2 weeks after the concrete is poured, unless the inner forms are braced and left in place.

Excavation: You will have to carry your excavation for foundation walls, piers or any supports for buildings, below the frost line, that is, at least 2 feet deep in

the southern states and 4 feet in the northern states. The depth of excavation will depend also on the character of the soil. You need a good, solid support. If the soil is spongy and soft just below the frost line, you will have to dig deeper, remove the soft material and then ram in cinders or gravel as a base. Where the soil is very soft, the bottom of the wall should be made wider than the wall itself. This provides a wider bearing base or footing that gives sufficient stability in soils that otherwise would not bear the load of the wall and superstructure.

Construction: For average houses and small barns, a 10 inch wall is thick enough. For larger houses and barns, foundations should be 12 inches thick. For small buildings like garages and poultry houses, 6 or 8 inches is enough.

Mixture should be 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone. Where water is encountered in the excavation, make the mixture

richer—as 1 part Atlas Cement, 2 parts sand, and 4 parts of gravel or crushed stone. This richer mixture makes a more dense concrete that will be waterproof if it is well tamped in the forms. See paragraphs 94-96, page 19.

Fastening building to foundation: If your building is to be wood on a concrete foundation, place bolts, head downward, at intervals in the concrete when you pour it. See Figure 18. Level off the concrete surface evenly and trowel it smooth. After the concrete has set and the forms are removed, put the wooden sill in place. It should have holes bored in it to conform to the bolts. Fasten it with nuts and washers on the upper side.

Amount Required: For every 100 cubic feet of foundation concrete, allow (for the $1:2\frac{1}{2}:5$ mixture) 18 bags of Atlas Cement, 45 cubic feet of sand, and 90 cubic feet of gravel or stone as explained on page 11. For the $1:2:4$ mixture, allow 22 bags of Atlas Cement, 44 cubic feet of sand, and 88 cubic feet of broken stone or gravel.

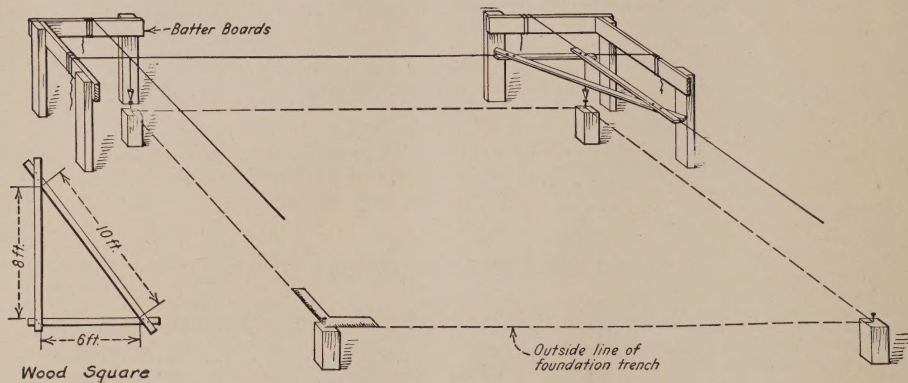


Figure 16—Method for laying out foundation lines by means of batter-boards. Notice large wood square used for testing squareness of corners. The small carpenters steel square, shown at lower left corner, is used only for very small structures.



Figure 17—Foundation wall constructed of concrete blocks. It is best to cover the outside surface of such a wall with a $\frac{1}{2}$ -inch coat of Portland cement mortar up to ground level. If the cellar is located in wet ground it is best to give the mortar coating several coats of coal tar pitch or asphalt, so as to prevent the entrance of water. (For information on insuring watertight cellar, write the Atlas Technical Department.)



Figure 18—Foundation wall for building, showing method for fastening wooden sill to the wall. Bolts shown are embedded head down in the concrete while it is still soft. Holes are bored in the wooden sill to correspond with the bolts and the sill is fastened down with a nut and large washer.

Replacing Old Foundations

It is frequently necessary to replace wooden or stone foundations that have decayed or deteriorated. Concrete can be placed in small or large quantities and can be molded to any shape. It provides a strong and lasting foundation that never need be replaced.

Supports and Forms—If you have an old foundation in which the wood is rotting or the stones or bricks are loose, the faulty substructure should be removed and replaced with a strong, durable foundation of concrete. Take great care in supporting the old building while you replace parts or sections of the old foundation. You can use jack screws or blocks of wood with wedges driven in to hold them in place.

Construction—Use concrete composed of 1 part Atlas

Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone. Be sure to secure an even bearing for the sill and have the concrete well spaded on the outside surface. After about two weeks, under favorable weather conditions, the concrete should be strong enough to stand the weight of the building. Then lower the building, remove the props and fill with concrete the spaces where the props were. For each 100 cubic feet of concrete to be made, allow 18 bags Atlas Cement, 45 cubic feet sand, and 90 cubic feet stone or gravel.

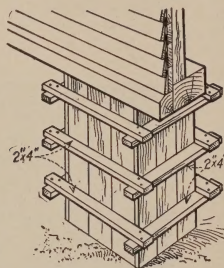


Figure 19—Upper left: Method of building form for casting pier of concrete to replace old foundation or wooden supports. Of course, it is necessary to jack up superstructures while concrete is being poured and is hardening. Jacks and temporary supports are not shown in the illustration. In photograph is shown concrete foundation under barn having a wooden superstructure.



Windmill and Water Tank Foundations

Concrete is very well suited for the construction of windmill and water tower foundations. It is strong, does not rot or decay. Wooden foundations usually must be replaced every few years. Concrete foundations last forever. They can be easily and cheaply constructed.

Excavation—Excavate for the four corner foundation piers. Go deep enough to get below the frost line, and if the soil is not firm, fill with cinders or gravel well packed in place. Build forms so as to provide for four foundation piers, each $2\frac{1}{2}$ feet square by 5 feet deep.

Fastening to Superstructure—Then construct a template to hold the bolts in place. These bolts should be large enough to extend within 2 feet of the bottom and, of course, far enough above the top to provide proper fastening for the tower. For a steel structure the bolts must be long enough to extend through the steel base far enough for the nuts to be screwed on. For a wooden structure the bolts must be long enough

to go through the wooden sill and allow washers below the nuts.

Mixture—The concrete should be 1 part Atlas, $2\frac{1}{2}$ parts sand, and 5 parts of gravel or crushed stone. Pour the concrete 6 inches deep at a time and then spade and churn it well in place. Be sure to allow the concrete to harden properly before it is used.

Quantities Required—Four piers of the dimensions given will require 23 bags Atlas Cement, 57 feet sand and 114 feet gravel or crushed stone. Two men can easily mix and place these piers in one day if materials are handy.

Engine and Machinery Foundations

Engines, cream separators, pumps, rams and other pieces of machinery require solid, durable foundations, free from vibration. No material is more suitable for this work than concrete. It is strong, rigid and permanent.

Size—Engine foundations should be large or massive enough to hold the engine firmly—free from vibration. For ordinary gasoline farm engines a foundation 3 feet deep and a little larger than the engine base will be satisfactory.

Fastening to Superstructure—Figure 20 illustrates an engine foundation and shows how it should be constructed separate from the floor. It also shows the template used for holding bolts in position when the concrete is poured.

The bolt should extend at least 1 foot into the concrete base and have an iron washer at the lower end. Put a piece of pipe, at least twice the diameter of the bolt, over each bolt, to allow a slight adjustment of the

bolts to the holes in the engine base. After the bolts are in the exact position desired, fill the spaces between them and the pipe with mortar of 1 part Atlas Cement and 1 part sand.

Mixture—Use for the foundation a mixture of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel. Let the concrete harden at least a week before the engine is placed on it. Don't begin using the engine until the concrete is two weeks old.

Quantities—For an engine base, $7\frac{1}{2}$ feet by 4 feet by 3 feet deep, you will need (of the 1:2½:5 mixture) 16 bags Atlas Cement, 40 cubic feet sand and 80 cubic feet gravel or crushed stone; and building it will take about 9 hours' time of two men.

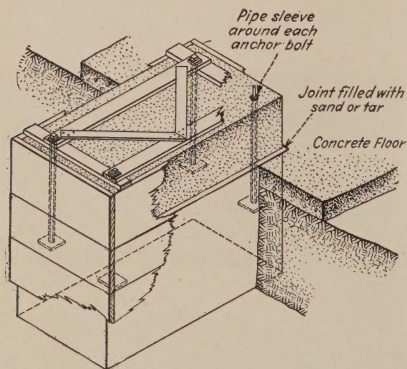


Figure 20—Method for locating foundation bolts in a machinery foundation. Joint between foundation and floor prevents vibration being communicated to floor.

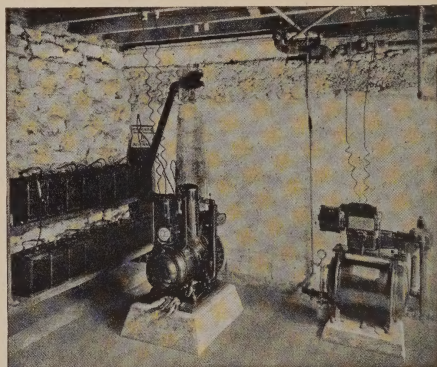


Figure 21—Concrete engine and pump foundations completed and in use.

What to do for "Hurry Up" Work

It sometimes happens that for one reason or another concrete must be placed in use very quickly after it is poured—for example, a foundation for a cream separator, or engine for driving some piece of farm machinery may have to be rebuilt or repaired very quickly in order to avoid interruption and loss. A culvert may be washed out or a piece of driveway required where considerable annoyance or delay would be occasioned while waiting a week or two for regular concrete to become strong enough to be put into use. For such emergencies a special cement is available known as Atlas Lumnite Cement. This is a special cement different in composition from Portland cement. Concrete made with this Atlas Lumnite Cement may be poured today, and put into use tomorrow, because it will have as much strength at the end of 24 hours, as Portland cement has in one month's time. Your dealer who furnishes you Atlas Portland Cement can also furnish you with Atlas Lumnite Cement.

How High Early Strength Concrete is Made—In general Atlas Lumnite Cement is employed in somewhat the same manner as Portland cement, except that because of its high strength qualities, greater care must be exercised in measuring, mixing, placing and protecting the concrete. Too much mixing water must be avoided, and the concrete must be kept wet from the time it will bear water without injury, up until 24 hours. Mixtures which are too rich must be avoided.

Atlas Lumnite Cement is not quick setting, which means that you will have ample time for mixing the concrete thoroughly and depositing it in place—in fact it is no faster setting than the regular Portland cement. After it begins to harden, however, it gains its strength with extreme rapidity. For more complete directions on how to use Atlas Lumnite Cement, ask your dealer or write to the Atlas Lumnite Cement Company, 25 Broadway, New York City, New York.

Root Cellars and Ice Houses

You know how important it is to provide a proper place for storing roots to be used as winter feed, and vegetables and fruits.

For a root cellar concrete is the most desirable material, because it is waterproof, will not rot, provides protection against rats and other rodents, and can easily be constructed with ventilator openings so that it will always be warm and dry.

For a small ice house on the farm, concrete is equally advantageous. As the construction of an ice house is practically the same as that of a root cellar, you can build one from the instructions given here for the other.

Location—The root cellar should be by itself, separate from any other building. The side that is entirely exposed should face south or southeast.

Types—Root cellars may be built with flat slab concrete roofs, arched roofs or pitched roofs. Sometimes they

are built largely above the ground; sometimes entirely under ground and covered with earth. The most desirable arrangement is to have the cellar built half below and half above ground. See Figures 23 and 24. Figures 22 and 25 are of types that are equally adapted to small ice houses.

Construction of a Concrete Root Cellar

The structure shown in Figure 22 can be built without any great difficulty. It is 20 feet long, 10 feet wide, and 7 feet high, inside measurements.

Excavation—First excavate 6 inches below the desired floor level of the root cellar, allowing an extra 10 inches at either end and sides for the width of the walls. At one end the earth should be dug out to a width of 4 feet and length of 9 feet, sloping up, allowing for a flight of steps. Each step is to have a rise of 7 inches and a tread of 10 inches. There should be a 3-foot landing at the bottom of the steps as shown in Figure 22. For information on building steps, see page 27.

Floors—In laying the floor it is better to make it one-course concrete, using 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. Make the floor 6 inches thick at the sides and $4\frac{1}{2}$ inches at the center—to provide a slope from all sides to the center for drainage. The building of floors is described on page 33 and following.

You can give the floor a smooth finish if you like by using a steel trowel or float, but when a wooden float is properly handled it will give you a floor that is smooth enough for all practical purposes.

Walls—The building of forms for walls has been explained in detail in the last paragraph on page 15. If the soil is reasonably firm and hard, you will have to erect forms for the inside surface only, allowing the earth to take the place of the outside form.

Use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

The concrete should be placed in layers 6 to 12 inches deep, and should be well spaded next to the forms. Carry on the work continuously, if possible; but if it is necessary to place concrete on successive days, clean off the surface of the concrete placed previously and treat it so as to provide a good bond between it and the new concrete; see what has been said on bonding, paragraphs 87-93, page 19.

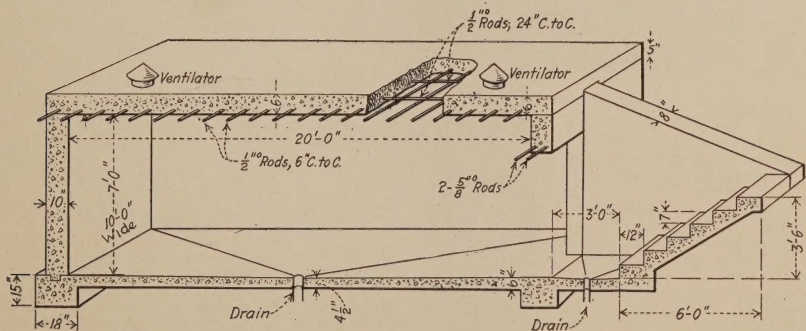


Figure 22—Plan of root cellar with flat reinforced concrete roof. Flat roof is easiest to build, but always must be reinforced.

Roof—The roof may be constructed of either wood or concrete. The wooden roof is simple of construction and will not be taken up here. The concrete roof is a permanent sanitary covering that will not rot or break down and is recommended for these reasons. The roof should have two ventilators as shown in Figure 22.

At least a week should elapse after the floor and walls have been poured before you begin the construction of the roof. This is the only part of the structure that need be reinforced. For reinforcing use $\frac{1}{2}$ -inch diameter round rods. Place them 1 inch from the bottom of the roof, and have them 6 inches apart, running crosswise, and 2 feet apart running the long way of the cellar. Use a 1:2:4 mixture for the concrete. Make the roof 6 inches thick at the center and 5 inches at the side to provide a slope. The forms and supports of the

roof should remain in place at least three weeks under favorable conditions before removal. For the construction of these forms and supports see paragraphs 76 and 77, page 17.

The amounts of materials required for a concrete cellar 20 feet long, 10 feet wide and 7 feet high, inside dimensions, are 175 bags of Atlas Cement, 350 cubic feet of sand, 700 cubic feet of gravel or crushed stone, 40 rods 11 feet 4 inches long, 5 rods 21 feet 6 inches long, all $\frac{1}{2}$ inch diameter.

After the cellar has been completed you can build bins of any desired size and height. Lumber is more commonly used for bins so that they can be built more easily and moved to any new position.

This same type of structure is sometimes used for an incubator cellar, a cyclone cellar or a bee cellar.

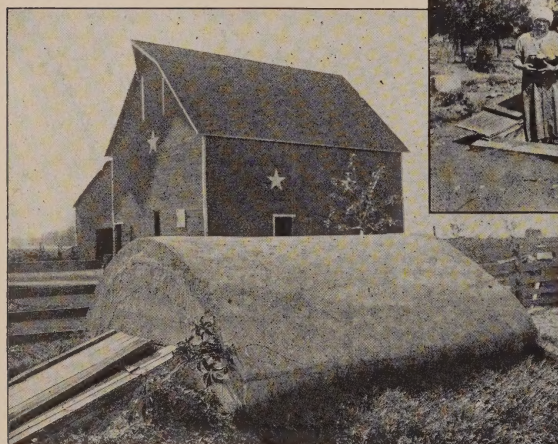


Figure 24—Above: Root cellar with curved roof. This type requires no reinforcing in the roof, although it is sometimes used as an extra precaution to prevent cracking.

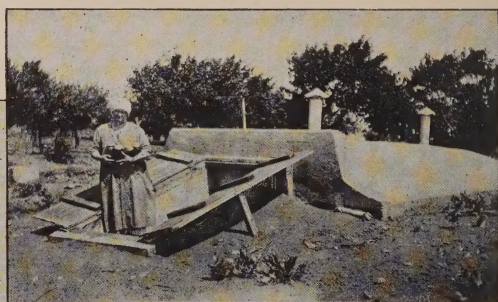


Figure 23—Above: Root cellar with flat roof. Notice ventilators installed in roof at time of pouring.

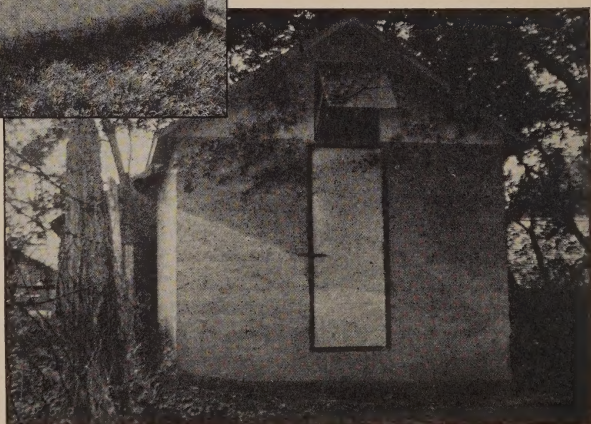


Figure 25—At right: Small concrete ice house with wood gable and roof. Concrete is rot-proof and fire-proof—very desirable qualities in an ice house.

Concrete Steps and Hatchways

Steps should be built of some permanent material which will not decay. This is particularly important if they rest upon the ground. Wooden steps constantly absorb moisture and therefore rot in a short time.

Construction of Concrete Steps

Types—Concrete steps are of two types: First, those which rest on the earth—that is, are built on a slope; and second, those which extend from one floor to another, or from the floor to the ground, and are supported at each end like a slab, so that they require reinforcement.

Taking up the construction of the first type of steps, those *built on a slope*: The slope should be thoroughly tamped and solid enough to hold the concrete without any settlement. Steps of this type are ordinarily not reinforced.

The *forms* consist of two planks held against side walls by 2-by-4-inch boards and wedges, as shown in Figure 27. To these are nailed 2-by-4-inch boards which come to within a couple of inches of the treads. To the 2-by-4's are nailed the cross planks (usually 2 inches by 8 inches), which form the risers.

If you build steps without side walls, then make your forms out of planks according to the risers and treads of the steps, and nail the forms for the risers to the planks. The forms are practically the same as for reinforced concrete steps, described below. (See Fig. 28.)

The *mixture* should be 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

You can safely remove the forms for the risers after 12 hours under ordinary conditions (in warm weather 6 hours is sometimes enough if care is exercised in removing forms) and then the face of the risers should be brought to a smooth finish by using a wooden float—rubbing the face well until it presents a smooth, even textured finish.

Self-Supporting Concrete Steps

In the second type, the concrete steps are built in a slightly different manner, since they are self-supporting.

Forms—The forms required as shown in Figure 28. They consist of a panel of $\frac{3}{4}$ -inch tongued-and-grooved sheathing, cleated together about 12 to 14 inches wider each side than the steps. This panel is supported on 4-by-4's running lengthwise of the steps. These are supported on 4-by-4-inch bents or posts, as shown in the drawing. Two-inch planks, cut to the shape of the steps, constitute the side forms. They are nailed to the panels and braced on the outside. Riser boards, 2-by-8-inches are nailed upright to form face of steps.

Mixture—Use concrete mixed in proportion of 1 part Atlas Cement, 2 parts sand and 4 parts gravel or crushed stone.

Reinforcement—Before the concrete is poured—better yet before the risers are put in position—place the longitudinal reinforcement as shown in Figure 29. This should be 1 inch from the bottom of the slab. The amount to be used is given in the table below.

It is usually satisfactory to remove the side forms within 24 hours after the concrete is poured. The riser forms may be removed earlier to permit finishing. To secure a satisfactory finish, rub the exposed surface with a wooden float dipped in water. The forms and shoring supporting the slab should be left in place for at least 2 weeks.



Figure 26—Three types of step treads with forms for making them. The first or second type is considered preferable.

Figure 26, on this page, shows three different types of riser forms. For 10 steps; with 7 inch risers, 10 inch tread and 24 inches long, you will need 2 bags Atlas Cement, 4 cubic feet sand, and 8 cubic feet gravel.

Hatchways of Concrete

Concrete steps are well suited for hatchway construction and for this purpose are usually of the first type, that is, built directly on a slope. This form of construction, shown in Figure 30, can be easily adapted to the particular conditions which you are called upon to meet.

Concrete walls forming the hatchway are built in the same way as basement walls (see page 15), and of the same thickness and mixture. Have them built at the same time that the basement wall is constructed, if you possibly can, so that they will tie into the main part of the wall. Bolts should be placed in the top of the wall when it is poured, so as to allow the cellar door to be anchored securely.

TABLE OF REINFORCEMENT FOR CONCRETE STEPS

No. of Steps	Clear Span		Thickness Slab	Reinforcement		No. of Steps	Clear Span		Thickness Slab	Reinforcement	
				Diameter	Spacing					Diameter	Spacing
	Feet	Inches	Inches	Inches			Feet	Inches	Inches	Inches	
4	2	2	4	$\frac{1}{4}$	10 inches	8	5	6	5	$\frac{1}{4}$	5 inches
5	3	0	4	$\frac{1}{4}$	10 inches	9	6	4	6	$\frac{1}{4}$	5 inches
6	3	10	4	$\frac{1}{4}$	7 inches	10	7	2	6	$\frac{3}{8}$	5 inches
7	4	8	5	$\frac{1}{4}$	7 inches	11	8	0	6	$\frac{3}{8}$	6 inches

(See drawings on Page 28)

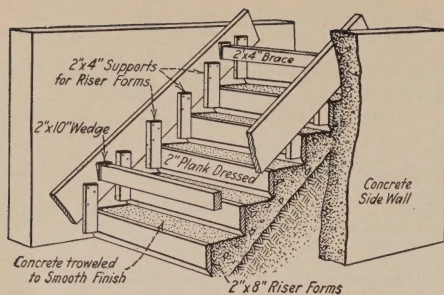


Figure 27—Construction of steps resting on the ground with two side walls.

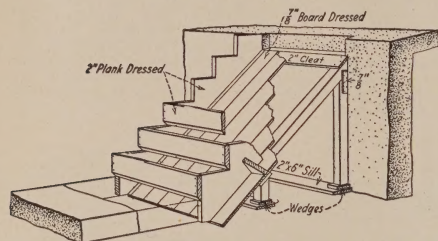


Figure 28—Form for building self-supporting steps shown below.

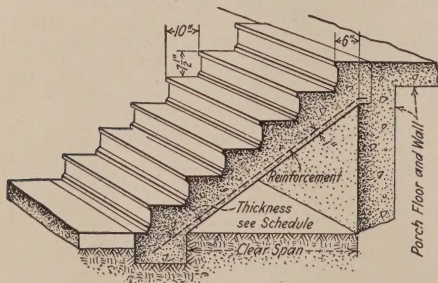


Figure 29—Completed self-supporting concrete steps showing location of reinforcing. (See table on page 27.)

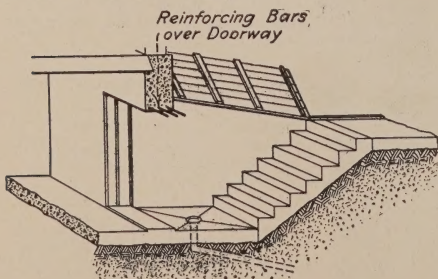


Figure 30—Concrete steps for cellar hatchway.



Figure 31—Photograph of steps built as shown in Figure 27.



Figure 32—Concrete cellar steps and hatchway.

Concrete Sidewalks

Concrete sidewalks are easily built, present a neat appearance, and are permanent. They furnish a safe and hard surface at all times of the year for convenient travel between or around the different buildings of your farm. They are never muddy, never dusty. It is easy to remove snow from them.

There are two types of concrete sidewalk construction: the *one-course* type, which is a uniform mixture of cement, sand and stone throughout; and the *two-course* type, which consists of a base of concrete and finish of cement mortar, made of cement and sand only. The advantages of the one-course type are that it is much more easily constructed and that there is a saving in the material required. The only advantage gained by the two-course construction is that the walk will have a smoother surface.

How to Build Them

Foundations—Precautions necessary to take in providing a proper foundation depend on the character of the soil where you are going to build the walk. Sandy soils drain themselves, but soils that are principally clay will hold water and cause it to accumulate underneath the walk. If you build a walk over soil that retains water or in a place where ground water comes near the surface at certain times of the year, you will have to see to it that the ground is drained to take care of any accumulation of water that may settle there.

Excavation and drainage—Excavation for walk construction in any self-draining soil need be only as deep as the thickness of the concrete slab for the sidewalk. Where the soil is not self-draining, you should excavate 10 to 12 inches and refill this extra 6 or 8 inches with cinders (not household ashes), gravel or broken brick to provide a porous sub-base which will drain off any water that might accumulate underneath the slab. If there is a likelihood that a large amount of water will accumulate underneath the slab at any time of the year, a land tile drain should be installed to take this water away from beneath the walk itself, to a lower level. Neglect of proper foundation preparation may cause complete failure of the walk.

Tree roots and other vegetable growths must be taken out from the soil beneath the walk at least 15 inches below the ground surface. Soft or sandy pockets in the sub-base should be filled with hard, firm material so that the ground sub-base upon which the concrete walk is to be placed will present a uniformly hard and well compacted surface.

Materials and mixing—The material required for concrete construction should be carefully selected—the selection of proper material is covered in paragraph 28, page 8. Mixing the concrete may be done either by hand or machine. See page 12.

Forms—The only forms needed are 2-by-4-inch planks set on edge and held in place by stakes driven in the ground on the outside. These forms restrain the concrete while it is still soft and so give it the desired shape for future use.

Expansion joints—Concrete sidewalks, whether of the one- or two-course type should never be constructed

in one piece. They must be divided into slabs or units, about 5 feet long. These joints or separations of the slabs provide for the expansion and contraction of the slabs as the temperature changes. They are made during construction of the walk by placing several thicknesses of tar paper or $\frac{1}{4}$ -inch boards across the walk between the side forms at intervals of 5 feet; the concrete is deposited on either side. If the $\frac{1}{4}$ -inch board is used, it may be removed when the concrete has set. If tar paper is used, it may be left in the walk without harm. Separation of the concrete into separate slabs is sometimes accomplished by cutting through the slab with a steel trowel or other sharp tool while it is still soft and before it is set. If you separate the slabs completely, this method is all right, but you should have a $\frac{1}{2}$ -inch expansion joint every 25 feet.

One-Course Type

Mixtures—The one-course concrete sidewalk is constructed of a mixture of 1 part Atlas Cement, 2 parts of sand, and 3 parts of broken stone or gravel. For each 100 square feet of sidewalk, 5 inches thick, allow materials as follows: 11 bags Atlas Cement, 22 cubic feet sand, 33 cubic feet of gravel or crushed stone—8 hours laboration of two men. Figure for any other thickness proportionately.

Thickness—The concrete is deposited between the forms, usually 5 inches thick, leveled off to the desired elevation of the walk surface by a strike-board, that is, any ordinary rough board with a straight and true edge—which rests on the side forms and is moved across and back with a sawing motion, and gradually worked forward also. The surface left behind the strike-board is true and uniform. The top of the concrete should be level with the ground, but never lower.

Finishing—The rough surface left by the strike-board should be allowed to set only until excess water is absorbed by the concrete mass. Then give it a final finishing with a wooden float (see Fig. 35). Do not use steel trowel or float for finishing, as it gives smooth surface that is likely to be slippery. The wooden float levels the surface, eradicates imperfections and leaves a sandy surface that is not slippery.

Two-Course Type

Proportioning—The *two-course concrete walk* is constructed of a concrete base-course mixture of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts of broken stone or gravel; and of a top or surfacing coat of cement mortar, made of 1 part Atlas Cement and 2 parts sand. Allow for each 100 square feet (for example, a walk 25 feet long and 4 feet wide), 4 bags of Atlas Cement and 8 cubic feet of sand for the mortar top coat, 1 inch thick; and for the base course, 4 inches thick, 6 bags Atlas Cement, 15 cubic feet sand, and 30 cubic feet gravel or crushed stone. To build 100 square feet, allow the labor of two men for about 10 hours.

Thickness—The base-course is deposited first, 3 or 4 inches thick—4 inches, if the walk must sustain heavy loads—and then roughly leveled off with a strike-board, as explained for the one-course type. Inside of 30 minutes the top or surfacing coat of mortar at least 1 inch thick must be placed on the base-course. If the top course is not placed almost immediately after the base-course, the two will not knit or bind together in a solid mass.

The mortar top coat may be struck off by means of a strike-board to the desired surface level, as with the one-course sidewalks.

The finishing of the two-course walk is usually done first with a wooden float to eradicate any great surface irregularities and then with a steel trowel. Too much troweling or floating should be avoided as it gives a very smooth surface. Besides, the steel troweling tends to bring the cement to the surface, and if that is done the walk will not wear as well as one that has the grains of sand close to the wearing surface.

Protection during curing—Protection of concrete from the elements on all exposed areas during the setting period has been explained already in paragraph 55, page 13, but particular precaution must be observed for sidewalks, as there is the absorption by the ground and evaporation from sun or hot winds. It is, therefore, usually advisable to cover the finished surface with canvas, burlap or tar papers. As soon as the concrete has set sufficiently to prevent pitting of the surface, it should be sprinkled and kept moist continuously for at least a week. A 2-inch covering of earth or sand will help to retain the moisture and prevent rapid evaporation.

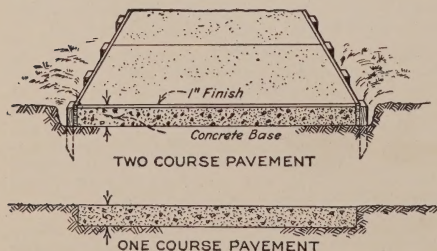


Figure 33—One and two-course sidewalk construction. Notice that the total thickness of both types are the same. In the two-course pavement there is a 4-inch base plus 1-inch top, giving a total of 5 inches, the same as for the one-course construction.



Figure 34—Constructing a two-course sidewalk—tamping the base course.



Figure 35—Floating the top of sidewalk for finish. Extremely smooth finishes are no longer popular, so it is best to use the wood float rather than a steel trowel as shown in the picture.

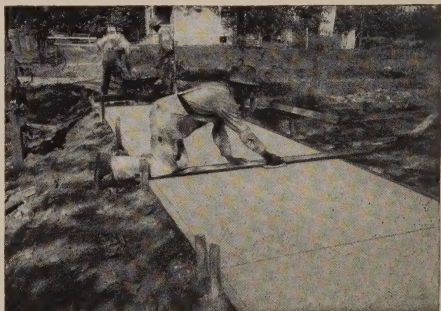


Figure 36—Marking sidewalks by means of a groover. While this groover is often used only to make a marking in the surface, there should be a complete joint through the entire depth of the walk for every 10 or 12 feet of length, to take care of contraction.

Concrete Driveways for the Farm

Driveways of concrete about farm buildings where there is considerable teaming assure easy access to the different buildings at all times of the year. They avoid the nuisance of mud holes and the mired loads that strain both horses and wagons. They are permanent and easily built.

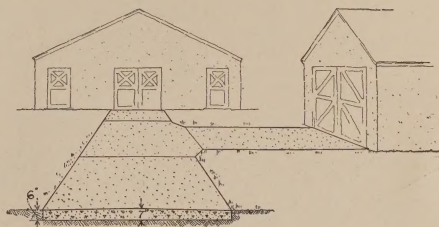
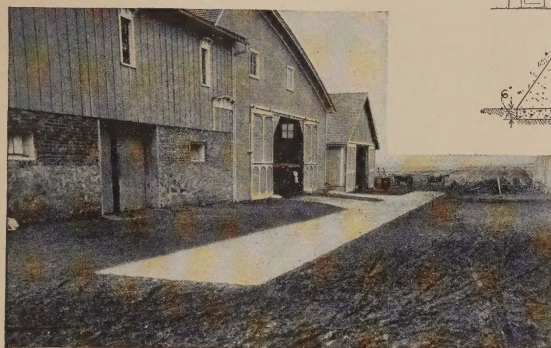


Figure 37—Above: Section of concrete driveway showing crowned surface to shed the water.

Figure 38—Notice the contrast between the clean, hard appearance of the concrete driveway, and the mud surrounding it.

Size—For farm trucking an 8-foot driveway is usually considered the minimum width. If loaded wagons have to pass, the road should be at least 12 feet wide.

Foundation—Instructions for drainage and foundation preparation are found on page 29, on sidewalk construction.

Thickness—For an 8-foot road the concrete should be 6 inches on the side and 7 inches in the center. This provides lateral drainage for surface water and keeps the pavement clean. For a driveway 12 feet wide, make the thickness 6 inches on the side and $7\frac{1}{2}$ inches in the center. For a 16-foot width, make the concrete 6 inches thick at the side and 8 inches at the center.

Placing and finishing—Place the concrete between side forms as in sidewalk construction; see page 30. The shape or crown of the road is given to it in finishing, with a template made of a 2-by-8-inch plank, cut

to the shape of the desired crown on its lower edge for a distance equal to the width of the road, but with the ends, beyond the curve, straight. With these ends resting on the side forms, the template should be drawn along, over the surface of the soft concrete..

A wooden float should be used to get rid of surface irregularities. The surface thus formed will be dense and gritty, never slippery, and will withstand any load. A wood bridge, consisting of a 2-by-10-inch plank supported at each end on a 10-inch upright base, makes it possible to bridge over the road and use the wood float without walking on new concrete.

Quantities required—For a roadway 8 feet wide, 6 inches thick on the side and 7 inches in the center, allow for each 20 feet of length (using a mixture of 1 part Atlas Cement, 2 parts sand and 3 parts of stone or gravel) 23 bags Atlas Cement, 46 cubic feet sand and 68 cubic feet gravel or stone.

Barn Entrances That Last

Entrance floors of concrete provide a permanent and safe entrance over the sill of the barn. The usual bump which jolts the load and strains the wagons and horses is easily prevented by constructing an incline of concrete, sloping from the entrance road surface to the level of the barn floor.

Foundation—There is considerable shock or strain on a barn entrance and it is, therefore, best to carry the foundation for the concrete at least 24 inches below the surface right at the door as shown in Figure 39 unless the foundation wall can be used as a support.

Excepting the foundation at each end, as shown in Figure 39, the approach has no foundation but is built right on the ground after you have excavated to a depth

of 6 inches. Use side forms for this as in sidewalk construction on page 30.

Mixture—Concrete mixed in the proportion of 1 part Atlas Cement, 2 parts sand, and 3 parts of crushed stone or gravel should then be placed on this rock foundation and shaped to the desired slope of the entrance incline. For an entrance 3 feet long, 10 feet wide and 6 inches thick, allow 6 bags Atlas Cement, 12 cubic feet sand and 18 cubic feet gravel or crushed stone.

(See page 32 for illustrations.)

Barn Entrances

(See page 31.)

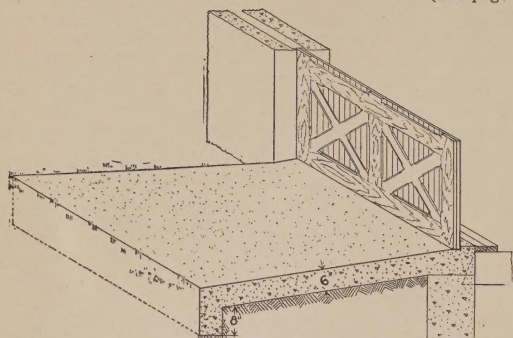


Figure 40—At right: Concrete barn entrance showing scored or grooved surface to afford good foothold for the horses.

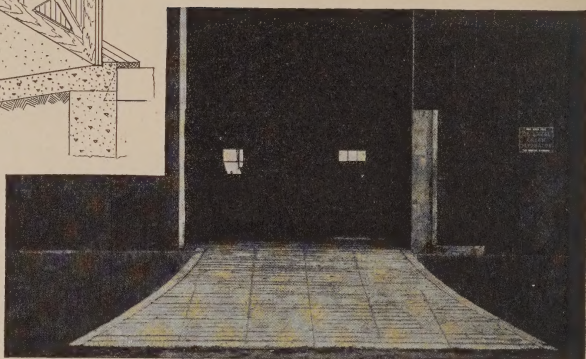


Figure 39—At left: Section showing construction of concrete barn entrance. Notice apron at front. Concrete does not need to rest on foundation wall as shown, but if more convenient may merely butt against it. For details on barn entrances, see page 31.

Barn and Stable Floors

Barn and stable floors of concrete used to be considered a desirable improvement. They are now considered a necessity. They are permanent and clean. Some state laws require them.

Foundation—The only foundation required is a firm compact soil area 5 or 6 inches lower than the floor level. This should be sloped to a drain or gutter, as in cellar floors; see page 29. If the natural soil is not firm and solid, you had better excavate about a foot, and then put in a 5 or 6-inch layer of gravel as a base, well packed down.

Floor—If you want your floor to slope, you must slope the grade before you start to pour the concrete.

If your floor is more than 10 feet in any one direction, build it in sections—any size you need.

Thickness, mixture, etc.—The concrete should be 5

inches thick if the loads hauled over it will not be heavy, but if you intend to haul hay or manure, the concrete should be 6 inches thick.

It should be mixed in the proportion of 1 part Atlas Cement, 2 parts sand, and 4 parts broken stone or gravel. The concrete should be finished with a wooden float only. Keep it moist for at least five days after it is in place, and protect it from travel for at least that long.

Quantities required—For each 100 square feet of floor (10 feet wide, 10 feet long, for instance), 6 inches deep, you will require 11 bags Atlas Cement, 22 cubic feet sand, and 44 cubic feet broken stone or gravel.

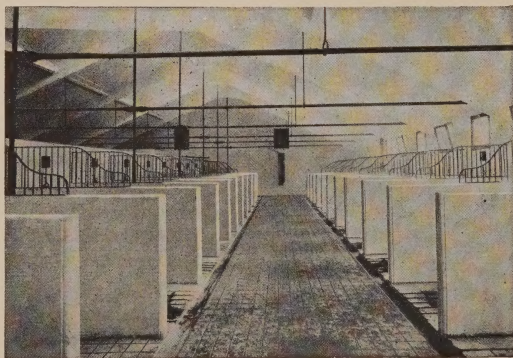


Figure 41—Interior of sanitary stable showing concrete floors and stalls.

Cellar Floors That Are Safe and Dry

Concrete cellar floors are the custom. They are sanitary because they are permanent, will not rot, have no cracks to accumulate refuse or vermin, and may be easily cleaned. They are fireproof.

Concrete floors, like concrete sidewalks, may be constructed in one course of two courses. See page 29. No expansion joints are needed in a basement floor where temperature changes are not great.

Excavation, drainage, etc.—

First excavate to a depth 4 inches lower than the finished floor surface is to be. Then tamp the ground thoroughly. If you wish to provide a drain so that the floor may be washed, this drain must be placed underneath the ground level before the cellar bottom is prepared for the concrete, and the sub-base or ground of the cellar bottom will have to be sloped so as to provide drainage from all directions into this outlet. Because the concrete is 4 inches thick throughout, the slope must be provided on the base and *not in the concrete*.

Forms—If the drain is to be in the center of the cellar, it is a good plan to set 2-by-4-inch boards on edge, sloping 3 inches from the four corners of the cellar to the drain in the center. By the height of these boards you can measure the thickness of the concrete. Any board with a straight and true edge can be used as a strike-board—that is, be drawn back and forth on these 2-by-4's so that the excess concrete is driven ahead of the strike-board leaving a perfect grade behind it.

Remove the 2-by-4's as soon as the concrete is placed around them, and as you take them out fill concrete into the space left. Stand on a 12-inch board while

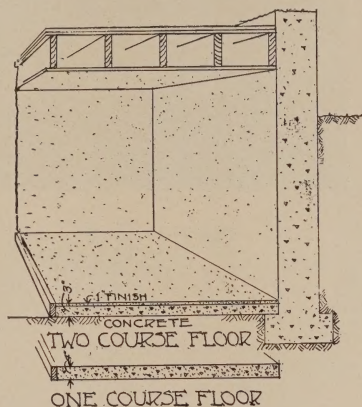


Figure 42—Two types of cellar floor construction. The one-course is easier to build, but the two-course can be finished with a smoother surface.

you are doing this—for you should not walk on the green concrete.

Mixture—For the *one-course* floor mix the concrete in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. Deposit it 4 inches thick. Level it off and finish it immediately, first with a wooden float and then with a very few strokes of a steel trowel.

For the *two-course* floor the mixture should be 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts crushed stone or gravel. Place this 3 inches thick. As soon as this has been struck off, the top or surfacing coat of mortar—a mixture of 1 part of Atlas Cement and 2 parts of sand—should be deposited over the concrete base about 1 inch thick and should be trowelled immediately to the desired surface with a steel trowel or float.

Material and labor required—

For each 100 square feet of *one-course* floor, 4 inches thick, you will need $7\frac{1}{2}$ bags Atlas Cement, 15 cubic feet sand, and 30 cubic feet crushed stone or gravel, and the labor of two men for about 8 hours.

For a *two-course* floor, of the same dimensions allow 8 bags Atlas Cement, 18 cubic feet sand, and 25 cubic feet gravel, and the labor for about 10 hours of two men.

Porch Floors

To replace an old wooden porch floor that has decayed, or to build a new porch floor, concrete is by all odds the best material to use. It is easy to construct a concrete floor, and it does not cost much. No repairs will ever be necessary. It will not rot, decay or burn. It can be easily cleaned.

Excavation—First—you will have to remove the old wooden floor and support the porch roof temporarily with 4-by-4-inch uprights. All loose material should be removed from the area which will be covered with concrete. As you will need a foundation and wall for the outer edge and sides of the porch dig a trench 3 feet deep, or at least below the frost line, and 10 inches wide.

Forms—Then construct forms for a concrete wall 10 inches thick. The method of building forms for this kind of work is described on page 15. Be sure that your forms for the front wall are set so that the top of your finished wall will be an inch or so lower than the inside

line where you will make the top of your porch floor. This will make your floor slope enough to drain easily.

Construct the wall of a mixture of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone.

After the concrete has hardened sufficiently, remove the forms and fill in the space between the front foundation and end walls and the main wall of the house with earth, to within 6 inches of the finished floor level. Tamp the fill thoroughly to get a good solid base. All fills settle slightly if not thoroughly tamped. Allow for

Figure 43—Concrete floors afford the maximum durability. In addition the smooth, jointless surface can easily be washed. The porch floor has an overhanging slab giving the effect of a coping which adds to the appearance of the porch. Sometimes concrete porch floors are given special decorative treatments as described in Chapter V.



Figure 44—At left: Sectional view of porch floor located on a fill. Notice joint between front wall and floor, allowing the floor to settle slightly with the fill without cracking. Settlement of the fill need be very slight if the fill is made in layers not over 6 inches thick and each layer carefully rammed and tamped

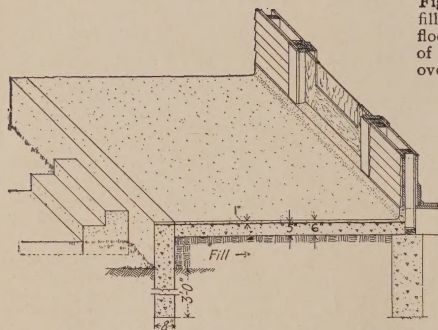
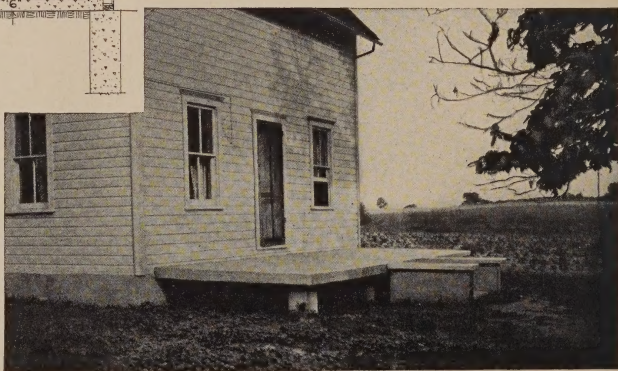


Figure 45—At right: Self-supporting porch floor. This type of concrete slab is reinforced so as to be self-supporting, as shown. If properly constructed, this type of floor is proof against cracking.



joints as shown on drawing to prevent cracks due to settlement.

Mixture—On this fill, place concrete mixed in the proportion of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone, to a thickness of 5 inches. Level this off and place immediately the top or finishing coat of mortar, 1 inch thick, mixed in the proportion of 1 part Atlas Cement and 2 parts sand. Finish with a steel trowel. Keep the floor moist for at least 5 days, to allow the concrete to set.

Quantities required—For a porch floor 5 feet wide,

20 feet long and 6 inches thick, with foundation walls, 3 feet below ground and $2\frac{1}{2}$ feet above, and 10 inches thick, you will need 31 bags Atlas Cement, 75 cubic feet sand, 134 cubic feet gravel or stone.

Self-supporting floor—A more satisfactory type of floor does not depend on a fill for support, but is reinforced with steel bars so as to support itself. The space under the porch is then available for storage purposes. For information on such floors write the Technical Department of the Atlas Portland Cement Co.

Curbs and Gutters

Concrete is the material commonly used for curb and gutter construction. It is adaptable to any form or shape; it is low in cost, and can be built at the same time as a driveway or pavement. It wears wonderfully, being waterproof and permanent.

Construction Is Easy

Types—There are two types—the single curb, and the combined curb and gutter. Their construction is identical, the difference being in their shape. The single curb is usually built 6 to 8 inches thick at the top, and 9 to 12 inches thick at the bottom, and 18 to 24 inches deep. The side next to the walk is vertical, and the side facing the gutter is at a slight angle—see Figure 47, which also shows how forms are constructed and braced. For dimensions of the combined curb and gutter—and the construction of forms—see Figure 46.

Excavation, forms, etc.—In constructing the curb first excavate to the required depth. Drain the soil if necessary, by excavating 8 inches more and filling in with gravel or cinders as a base. Build forms for the entire height, as shown in the drawings below, unless the earth is so firm that they need only be built for the part above ground.

Expansion joints must be provided about every 10 or 15 feet in the length of the curb. This is done by placing a board at the end of the form against which the concrete is poured. This gives a square end. Against this end place a thin piece of steel or wood or a couple of thicknesses of tar

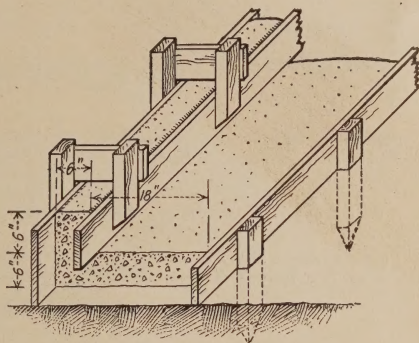


Figure 46—Form for constructing a combined curb and gutter. These home-made forms are built of wood. Notice method of supporting form for the inside face of the curb. Where a considerable amount of curb is to be laid it is much more convenient to use the manufactured steel forms which are provided with special means of fastening and holding in exact line.

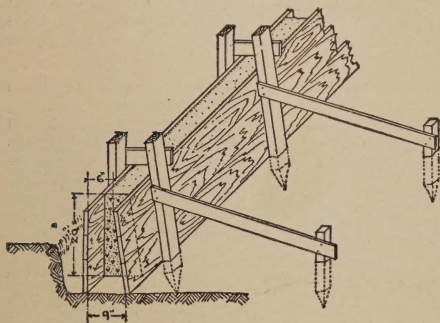


Figure 47—Form for building plain concrete curb. A common error is to make concrete curbing too shallow. In severe climates it should be carried down below ground level even further than shown on the drawing. This is to overcome the effects of frost as much as possible. Notice that when using a home-made wood form like the one shown, the curb should be constructed before the pavement so that stakes can be driven for holding the form on both sides. In such cases the curb then acts as a form for the pavement and it is only necessary to place several layers of tar paper against the curb where the pavement is poured. The tar paper acts as a joint to allow expansion and contraction.

paper when the next section of the curb is poured to leave a slight opening. The steel or wood should be removed but the tar paper can be left in place.

The mixture should be 1 part Atlas Cement; 2 parts sand, and 4 parts gravel or crushed stone with particles not larger than 1½ inches.

Quantities required—For every 100 feet length of curb, such as shown in Figure 47, using the above mixture, there will be needed 24 bags of Atlas Cement, 48 cubic feet of sand, and 96 cubic feet of gravel or crushed stone. For the same length of curb and gutter, made as in Figure 46, you will need 30 bags Atlas Cement, 60 cubic feet of sand, and 120 cubic feet of gravel or crushed stone.

Note—Two-course construction for curbs was formerly the customary construction, but there is a general tendency at the present time toward one-course work—the same mixture throughout. It is easier and cheaper to handle. By properly tamping and spading the concrete and then removing the forms as soon as possible and troweling the surface, you will obtain a good finish.

Economical Cow Barn Floors

Cow barn floors of concrete are best because they will not absorb the moisture and odors of the stables, and hence provide a sanitary surface which you can easily keep clean. Concrete floors are cheap because they are permanent and do not rot or decay, nor require upkeep or renewal expense.

It is not necessary, in order to have sanitary cow barn floors, to build an entire new barn, and it is part of our object in this section on cow barn floors, to show you how you can put a modern up-to-date floor in a barn building which you now have. You can build one stall or 100 on the basis of the plan which we show in this section.

Plans for Model Cow Barns

Figures 49, 50 and 53 show sections of a standard cow barn floor, arranged so that the cows face toward the center of the barn. With this arrangement there can be a central feed alley, where the fodder and grain can be fed from the driveway running through the center.

Figure 52 shows a section through a cow barn where the cows face toward the outside of the barn. This

arrangement is better for removing manure. The 8-foot driveway through the center allows for a central driveway through the barn and the manure may be shovelled directly into a wagon and taken from the barn without re-handling.

Both these layouts allow for 35-foot barns, with stalls each 4 feet 8 inches, mangers 3 feet 6 inches, and gutters 1 foot 4 inches.

Easily Built in Concrete

Construction—Do not try to construct the floor clear across the building or for the length of your cow barn in one operation, but take a small section, say half the width of the barn and three or four stanchions long. Excavate the floor of the barn 5 inches below the desired grade of finished floor, because the concrete will be placed 5 inches thick.

Figure 49 shows how to obtain the levels for the different sections, as the litter alley, the gutter, the stall, the manger and the feed alley. Follow this method if you desire to construct the floor in parts, and then you can do one section and be sure that the next section when it is joined to the one previously placed, will be in the right position and will join properly.

If you want to have the gutter slope to the manure pit so as to save and utilize the liquid manure, then the sub-base (or ground upon which the concrete is placed) must be sloped not less than one inch to every 4 feet, and not more than 1 inch to every 2 feet, to allow the liquids to drain to the sump or manure pit.

Be very careful to pack the ground thoroughly after excavating to the desired level and before you place the concrete. Fill up any irregularities or soft places with firm soil.

Forms and mixture—For division forms use planks set on edge and staked in the sub-grade, so providing a barrier against which the plastic concrete is deposited and held in place until it has had sufficient time to set. Use 1 part Atlas Cement, 2 parts of sand, and 4 parts of crushed stone or screened gravel. Mix the concrete thoroughly. Make it only sufficiently wet to allow water to come to the surface when the concrete is thoroughly packed in place. When you have thoroughly mixed the concrete, deposit it 5 inches thick between the division forms.

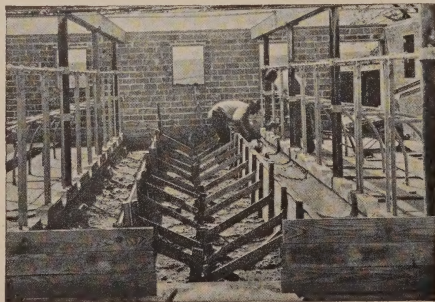


Figure 48—Constructing a concrete manger. Notice that the manger is built before the floor is laid, as shown in Figure 53.

Surface finishing—Careful tamping will bring the concrete surface to approximately the desired grade; then by means of a wooden float give the surface the final finish, which will be non-absorptive and gritty but not so slippery as if a steel float or trowel were used for finishing.

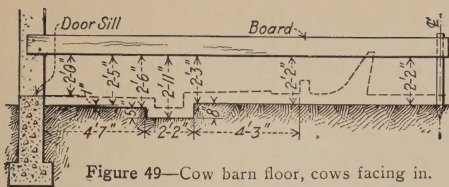


Figure 49—Cow barn floor, cows facing in.

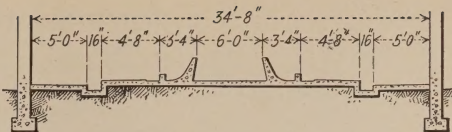


Figure 50—Same arrangement as shown in Figure 49, but giving the entire width of barn with two rows of stalls.

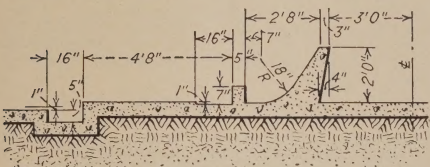


Figure 51—Drawing shows dimensions of manger and gutter.

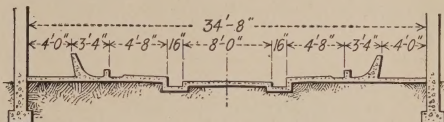


Figure 52—Arrangement of stalls with cows facing out.

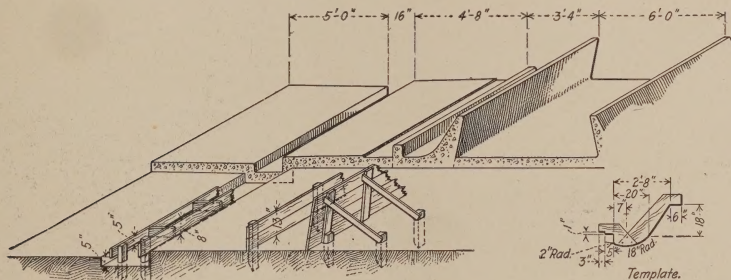


Figure 53—Detail of forms for cow barn floors, gutters and mangers. Notice that gutters and mangers are constructed first and the floor in between afterward.

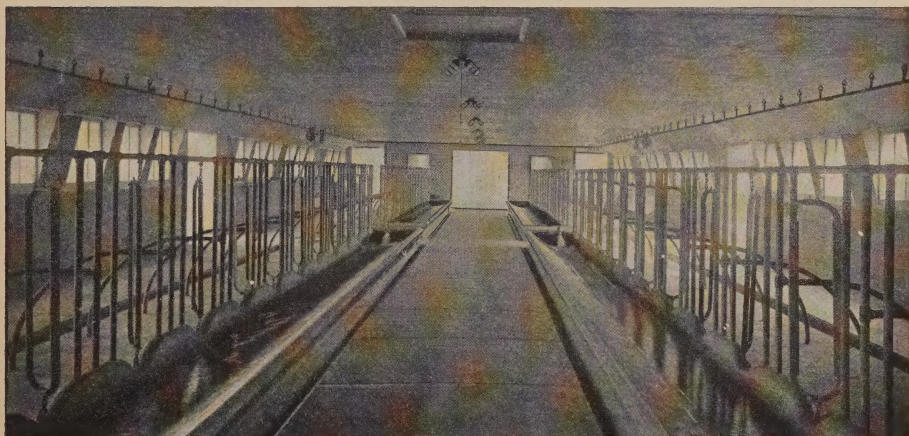


Figure 54—Example of sanitary cow barn of concrete. Notice that in this arrangement the cows are facing in, as shown in Figure 50.

Concrete Barnyard Pavements

Concrete barnyards are clean and free from mud and filth at all times of the year, and they preserve the manure for hauling to the land where it is of value.

Construction—The foundation of a barnyard pavement must be given careful attention. If the location of the barnyard is such as to allow water to accumulate, follow the instructions on page 29 for installing a porous underdrainage for sidewalks. If the soil and surrounding area is self-draining the excavation need only be carried to a depth equal to the thickness of the pavement—6 inches. When you are ready to place the concrete divide the area into 6-foot squares with 1-by-6-inch boards set on edge and staked to grade—that is, with the upper edge level with the finished grade of the pavement, as desired. If a slope in any direction is desired, slope the grade before placing the form boards. These boards act as guides for thickness and slope and divide the area into 6-foot squares. The concrete must be deposited and allowed to harden only in alternate

squares. After the first squares have set, remove the boards, put in vertically 2 strips of 3-ply tar paper and fill in the remaining squares. This provides contraction and expansion joints for the concrete. Place the concrete in these areas mixed in the proportion of 1 part Atlas Cement, 2 parts sand, 3 parts crushed stone or gravel. Strike off the soft concrete by a straight-edge board resting on the 1-by-6-inch forms, and finish with a wooden float.

Quantities required—A barnyard like this will need, for each 500 square feet of surface (20 feet by 25 feet, for instance), supposing it is 6 inches deep, 65 bags Atlas Cement, 130 cubic feet sand, and 195 cubic feet gravel or crushed stone. You can figure quantities required for different sizes in proportion to this or by referring to the table on page 10.

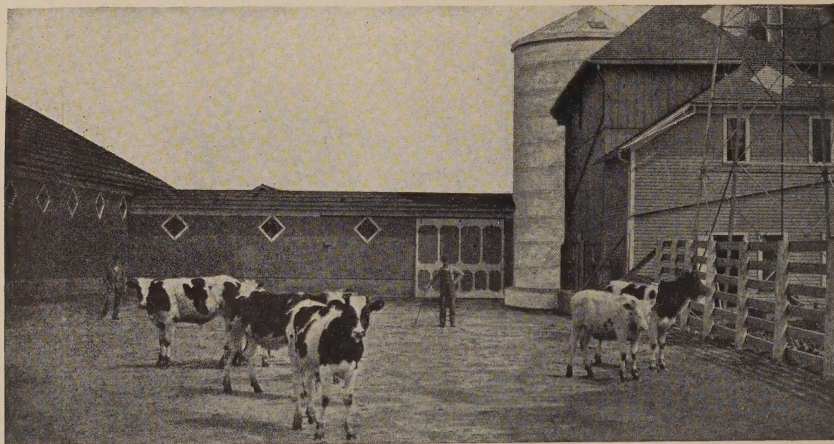


Figure 55—A clean and sanitary barnyard pavement of concrete.

Feeding Floors

When feed is tossed on the ground to hogs and cattle, they trample part of it into the ground. Feeding floors save this. They can be wood or concrete. A wooden floor is serviceable for a while but will not last, as it has to be laid on the ground and will eventually rot and decay; and even with a wooden floor, the cracks between the planks cause some loss of valuable feed and manure. The concrete feeding floor is the logical type to build. It has no cracks or seams, is free from decay, economizes on feed and manure, can be constructed easily and, as a general rule, will save its cost in a couple of years.

How to build—After having secured a good well-drained compact foundation (as explained for pavements and walks, see page 29), construct the floor 5 inches

thick of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. Lay it in sections 6 feet square. Use 1-by-6-inch boards for the side forms, staked up-

right. Let the floor slope to one side.

Sometimes a curb is built around the edge, 4 inches higher than the floor, to prevent hogs and cattle from shoving off the feed. When this is done, the curb is usually extended into the ground at least 18 inches in order to prevent the hogs from rooting under the floor. This curb should be at least 5 inches thick.

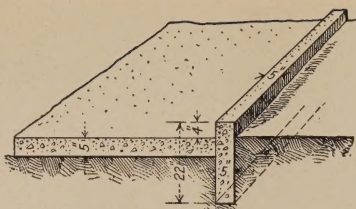


Figure 56—Diagram showing construction of feeding floor. At the right the apron or curb wall is to prevent hogs from rooting under the floor.

The inside form for this curb is a 2-by-4-inch board held in position by overhanging cleats from the stakes of outside forms. A convenient method is to build the curb first, since the forms on both sides can be held by stakes in the ground. The finished curb then becomes the form against which the floor can be poured. See Figure 47, page 35, in the description of curbs.



Figure 57—Concrete feeding floor in use. The saving in feed on such a floor will pay for the cost of the floor in a few years.

Automobile and Carriage Washing Floors

Washing floors constructed of concrete will not rot and are far more attractive than wooden floors. They provide a good, clean place for washing carriages or automobiles, and they do away with a mudhole near the barn or garage.

Size—Build the floor big enough to take not only the wheels of the rig but the shafts or tongue as well. Make it large enough to give the person who does the washing room to work on. The average size is about 12 feet square.

Construction—The concrete should be 5 inches thick throughout. Slope the earth each way toward the center and provide a drain—otherwise the water will run off the sides, taking with it the dirt from the vehicle. A convenient way to build a drain is to excavate, directly in the center, a hole big enough for a large sized barrel. Knock out the bottom of the barrel, set it in the hole, and

fill it with field stones. If the soil is clayey so that the water does not drain readily from the barrel, it will be necessary to run a drain from the barrel, as shown in the illustration, to some convenient point.

Mixture—Mix the concrete in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. Finish with a wooden float.

Quantities required—To build this 12-foot square concrete floor, you will need 13 bags of Atlas Cement, 26 cubic feet of sand and 52 cubic feet of gravel or crushed stone. It ought not to be more than a day's work for two men.

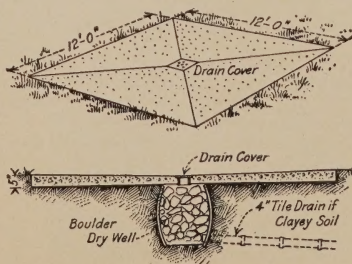




Figure 58—Interior of milk house with concrete cooling tank. Notice the sanitary appearance of this room due to the use of concrete.

Dairy and Milk Houses

A dairy or milk house should be built so that it can be cleaned easily and kept free from decaying material of any kind; its walls and floors should contain no cracks that will hold vermin or refuse. City and State health authorities are becoming more rigid in their rules how milk should be handled. The wise dairy farmer sees the importance of having good sanitation—even better than the law requires.

Dairy experts are enthusiastic about concrete. If you build your foundation, floor, cooling tank, and walls all of concrete, you will have a thoroughly sanitary, permanent structure.

The design of such a house is simple. It can be easily built and is reasonable in first cost—sometimes even lower than wood—and costs nothing for upkeep, painting, or repairs.

Location—Build your dairy house *convenient to the barn* and along a driveway, if practical. But keep it entirely separate—even if it is built next to the barn. See Figures 60 and 61. Avoid building the dairy house too close to hog pens or manure pits, etc. The north side of the barn is a good location if it is feasible, be-

cause the barn will afford a certain amount of protection against the sun. All these points should be considered and the house located accordingly.

The dairy house should be used for nothing besides the handling of milk. It should contain a cooling tank and may have a cream separator. The larger dairy houses have an ice house adjacent with a refrigerating room built in a section of the ice house. They may also contain larger working spaces, such as rooms for making butter, etc.

How to Build in Concrete

Construction—The house may be built of monolithic concrete or of concrete blocks. Either method is good. When concrete blocks are used, plaster the interior with cement mortar (see page 19, paragraphs 90-92) to provide a smooth, even surface free from cracks.

Let us consider a house 10 by 12 feet inside dimensions (see Figure 59). The first thing to do is to excavate to a depth of 3 feet and construct a good foundation. The building of foundations has already been taken up in detail on page 21, and what has been

written about the construction of foundations in general applies in this instance. For a house this size, build the foundations 10 inches thick; of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone.

Floor—The floor may be laid directly on the ground, but be sure to have the soil well packed down and thoroughly drained, if draining is necessary. If you have to fill, in order to secure the desired level, have the material well tamped. Level the floor carefully. Lay a concrete floor 4 inches thick of a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. One-course concrete will be suitable, and it will save

the expense of putting on a finish coat. Further information on floors may be found on pages 33 and following.

Walls—Walls should be 6 inches thick for a house of this size. For wall forms see page 15. Put window frames in their proper places during construction of the wall and reinforce the concrete over these openings with two 1-inch diameter rods placed 2 inches above the opening. Reinforcement is needed above all openings.

Use a concrete mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. You will have to use buckets or wheelbarrows to handle the concrete. If you are going to use wheelbarrows, you should build, first of all, scaffolds around the wall forms and construct runways, at least 20 inches wide, with the boards lapped in the proper direction for easy wheeling of the loaded barrows. After the concrete has been mixed, it can be put in wheelbarrows, wheeled up the runway and then dumped into the forms.

When the mix is placed in the forms it should be well spaded on both the inside and outside, to work the larger stones away from the surface and to bring the sand and cement next to the form, thus providing an even finish. Rapping the forms with a mallet while depositing the concrete will help to prevent air pockets in the concrete

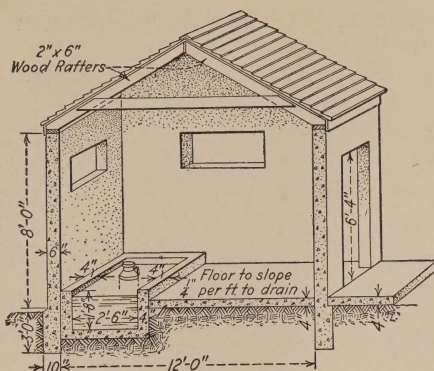


Figure 59—A small milk house measuring 10 feet by 12 feet provided with concrete foundation, floors, walls and cooling tank.

and will give a better finish. After the forms are removed, the wall may be treated by rubbing it with a concrete brick or carborundum stone. Sometimes the walls are left in the condition they are in when the forms are removed, and if the forms have been tight and evenly built, and the concrete well spaded, the appearance of the surface is satisfactory without any further treatment.

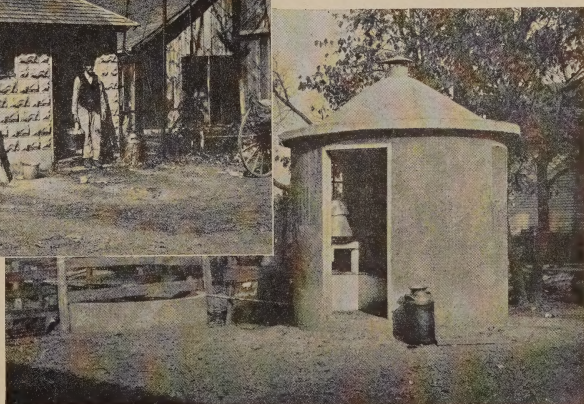
The cooling tank in Figure 59 is 2 feet 6 inches wide, 1 foot 8 inches deep, 9 feet 4 inches long, inside measurements. Its walls are all 4 inches thick. The bottom is 6 inches thick. The concrete is a mixture of 1 part Atlas Cement, 2 parts sand and 4 parts gravel. Building concrete tanks is a subject in itself, and is treated on page 58. This tank will hold 14 cans, each 14 inches in diameter. Either concrete or wooden partitions may be used to separate the tank into compartments. Concrete partitions are best, thus removing any danger of rotting in an otherwise permanent concrete tank.

The quantities of materials for this all-concrete dairy house with the dimensions given, are: 96 bags of Atlas Cement, 200 cubic feet of sand, 400 cubic feet of gravel, and for reinforcement: 6 rods, 1-inch diameter and 6 feet long, for use over window openings, and 2 rods, 1-inch diameter, and 4 feet, 6 inches long, to be used over door opening.



Figure 61—At right: Small circular milk house with concrete roof. This type is somewhat troublesome to build unless circular forms are available.

Figure 60—A milk house of concrete blocks. Blocks should be plastered on the inside surface to give a smooth, sanitary finish.



Small Buildings for the Farm

Smoke Houses, Hydraulic Ram Houses, Pump Houses, Acetylene Gas Plant Houses, Tool Houses, Coal Houses, Gasoline Engine Houses.

There are a number of small farm buildings that may be listed together here—all best built of concrete.

A smoke house should be proof against fire, and for this reason concrete is most suitable.

Hydraulic ram houses and pump houses have to be near to springs or wells, and so they rot quickly if they are constructed of wood. Some durable material is needed which will not require repair or deteriorate in any way. Concrete should therefore be used.

For acetylene gas plant houses concrete is used because it is fireproof and permanent.

For other small farm buildings, such as tool houses, coal houses and gasoline engine houses—concrete is certainly the best material to use for the foundations and floors. Sometimes wood can be employed to better advantage for the walls and prepared roofing of some kind may be used to good purpose for the roof.

The general method of constructing these buildings is according to the principles previously described. They are all easily built from the general instructions already given under forms (page 15), foundations (page 21), roofs (page 17), floors (page 33) and milk houses (page 40).

You will note in the illustrations here and elsewhere that quite a few buildings are of concrete block construction. This is a simple method and very often is chosen because the blocks can be built in spare time—or bad days—by installing a simple block-making machine in the cellar, or good block may be obtained from your local manufacturer of concrete block at a reasonable cost. Another frequent use of concrete blocks is in home construction for the first few feet, just above the ground level.

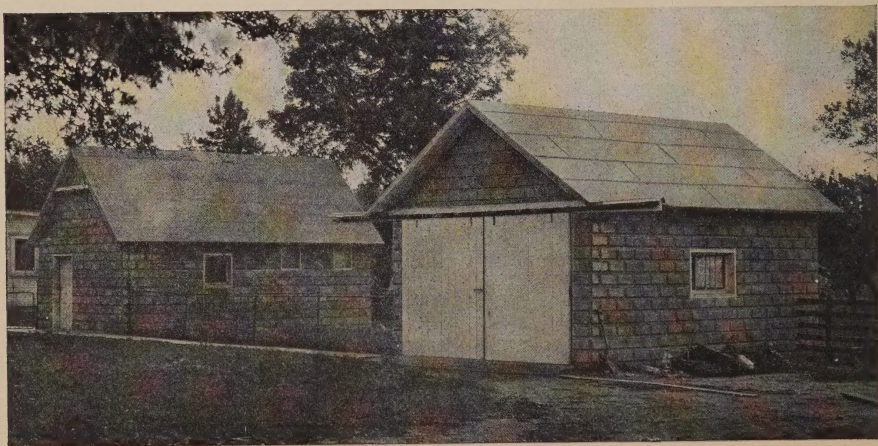


Figure 62—Farm garage and concrete power house built of concrete blocks.

Small Farm Buildings Built of Concrete

Figure 63—An all-concrete smoke house which is fire-proof and permanent.

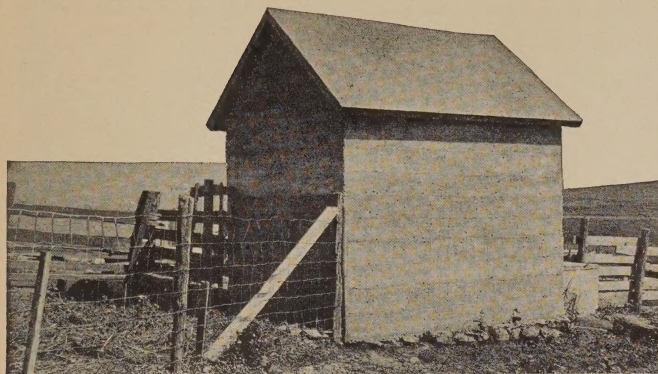


Figure 64—At right: Concrete block pump house with wind-mill tower built above it. Notice the concrete water trough at left.

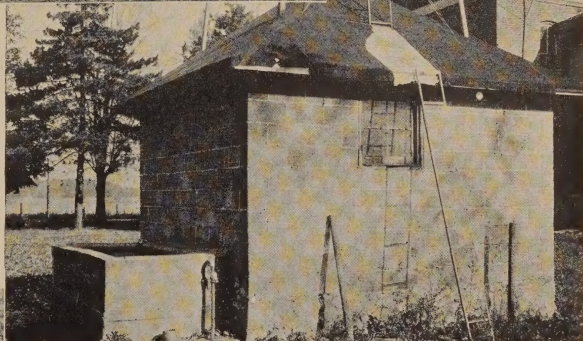


Figure 65—Below: Concrete engine house with wood roof.

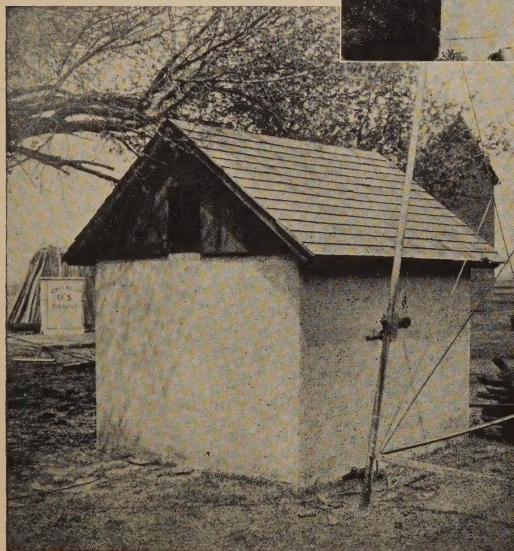


Figure 66—Below: Small concrete block house for hydraulic ram.



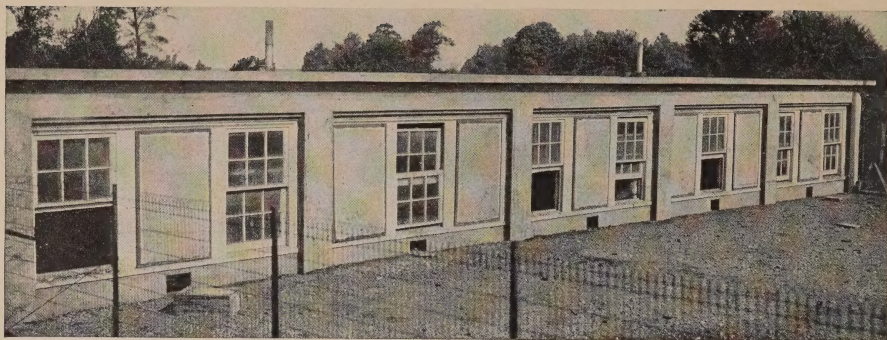


Figure 67—A very well built concrete chicken house. This construction is ideal for a large poultry farm where the utmost in permanence and sanitation is desired.

Concrete for Chicken Houses

In planning your poultry house you should first consider where you will build it.

The place must be thoroughly dry, because dampness causes more poultry diseases than anything else does.

If the site that you have selected for the house is not dry it should be made so either by filling or putting in drains. The most desirable location would be on a slope toward the south.

Fowls are particularly susceptible to ill effects of bad air. A noted authority says "200 five-pound hens, while weighing approximately the same as a cow or horse, will breathe from $2\frac{1}{2}$ to 3 times as much air in the same length of time." Hence every provision should be made for giving proper ventilation and furnishing an adequate supply of fresh air, but air should be admitted in such a way that no draughts will be produced. The desired ventilation is easily provided by the open-front type of poultry house. This has several modifications and has been practically adopted as standard. The open-front

house is tightly enclosed on all sides except the south, towards which the house faces. The south side is constructed so that it is practically open to the fresh air. The openings are covered with muslin or cheese cloth which provides free ventilation without draughts and excludes cold damp winds.

By facing the house toward the south you secure maximum of sunlight. Sunlight is an efficient aid in the destruction of disease germs, and the heat that is carried with the sun's rays is very desirable.

How to Build Chicken Houses

Figure 71 shows a standard poultry house, constructed in the most economical manner. It has a concrete foundation, wooden walls and roof and open side. Figure 67 is all-concrete—an ideal construction for an elaborate poultry farm. Figure 69 has all-stucco walls and wooden roof.

Floor—From 2 to 5 square feet of floor space should be allowed for each bird. Some poultrymen desire only dirt or gravel floor where the house is raised above the level of the surrounding ground and where it will at all times of the year be perfectly dry. Others desire tight board floor well littered with straw, and some find conditions more clean and sanitary where the floor is constructed of concrete and kept covered with straw or sawdust. A floor constructed in this manner prevents harboring of rats or other vermin.

The house itself may be constructed of concrete, or in part concrete, as in Figures 69 and 71, or of any durable lumber available. For studding, 2-by-4's can be used. For roof rafters use 2-by-4's or 2-by-6's, depend-

ing upon the size of the house. The details shown on the following page explain the arrangement and construction.

The roof is a very important part of the house and must be water-tight. Shingles or tar-paper may be used.

The roosts, dropping boards and nests are placed in the back of the house. Protect them during severe winter weather by muslin or duck curtains hanging from the roof to within one foot of the floor.

Painting adds much to the appearance and to the service of a chicken house. Whitewashing the interior of the house adds to its appearance and is a great assistance in keeping the house clean, fresh and sanitary. An excellent whitewash disinfectant can be made as follows:

Mix: 1 peck unslacked lime.
2 lbs. common coarse salt.
1 gal. crude carboric acid—dilute to 40 gal. with water.

Sanitary Poultry Houses

Figure 68—At right: Poultry house built of concrete blocks.

Figure 69—Below: A handsome stucco poultry house.

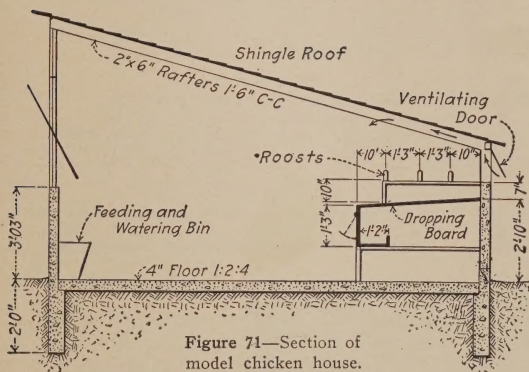
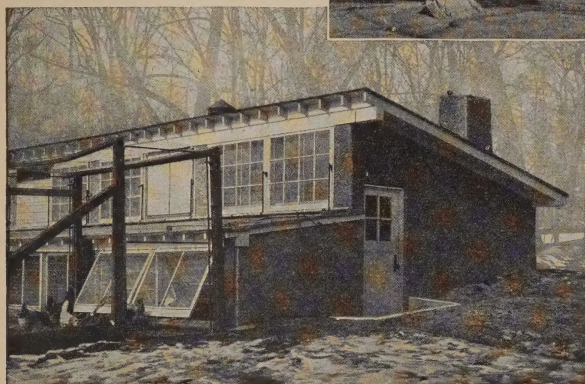
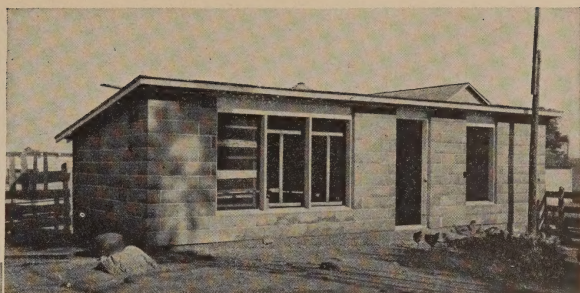


Figure 71—Section of model chicken house.

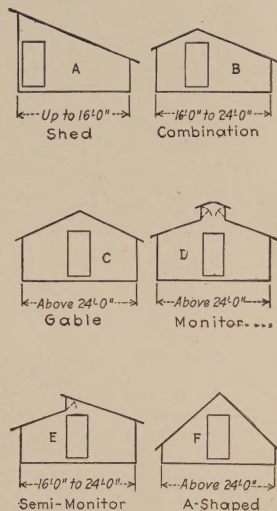


Figure 70—Different types of chicken house roofs. Notice that type A is the same as shown in Figures 67, 68 and 69.

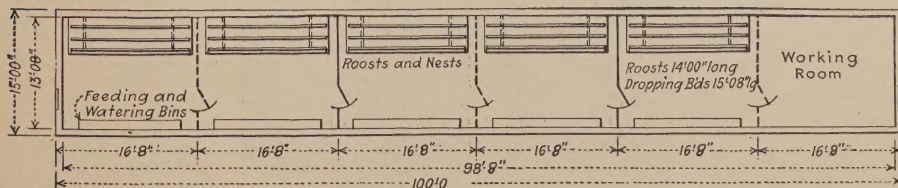


Figure 72—Floor plan for chicken house with workroom and five rooms for fowls.



Figure 73—Interior of concrete greenhouse with concrete curbs for walks and plant-beds.

Concrete for Greenhouses

Greenhouses should be constructed of a material that will require little or no repairs, and that will keep the air inside warm and moist during the severest winter weather. The use of concrete means a good permanent structure, with little danger of fungus growth or bad conditions of heat and moisture.

Construction—The thickness of the *foundation wall* depends upon the dimensions of the building. Under ordinary conditions, a foundation wall 10 inches thick will prove sufficient. It must be deep enough to extend below the frost line. The foundation concrete should be a mixture of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, 5 parts gravel or crushed stone. Forms and construction of the foundations are described on pages 15 and 21.

For ordinary greenhouse *walls*, 6 inches is the proper thickness. Use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. When the concrete is poured, bolts should be set vertically (as in Figure 18, page 22), about 2 feet apart to allow the steel or wooden frame-

work as the case may be, to be fastened securely to the concrete walls.

Figure 75 shows the exterior of a greenhouse. The interior view of another greenhouse, Figure 73, shows the arrangement of alley-ways and beds.

The concrete *curbing* shown, which holds the earth in place for the beds, is 6 inches thick and 1 foot above ground, and 2 feet below. The construction of this curb is the same as for an ordinary wall; use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

To figure the quantities of cement, sand and gravel necessary to build a greenhouse, figure separately the amounts for foundations and walls (see page 21), and curbs (see page 35).

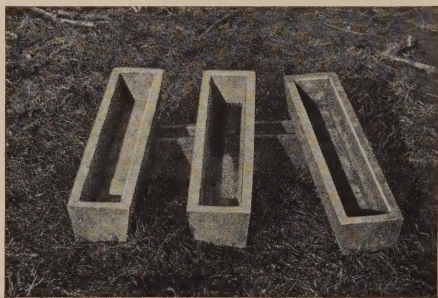


Figure 74—Concrete trays for the greenhouse which are easily made of concrete.

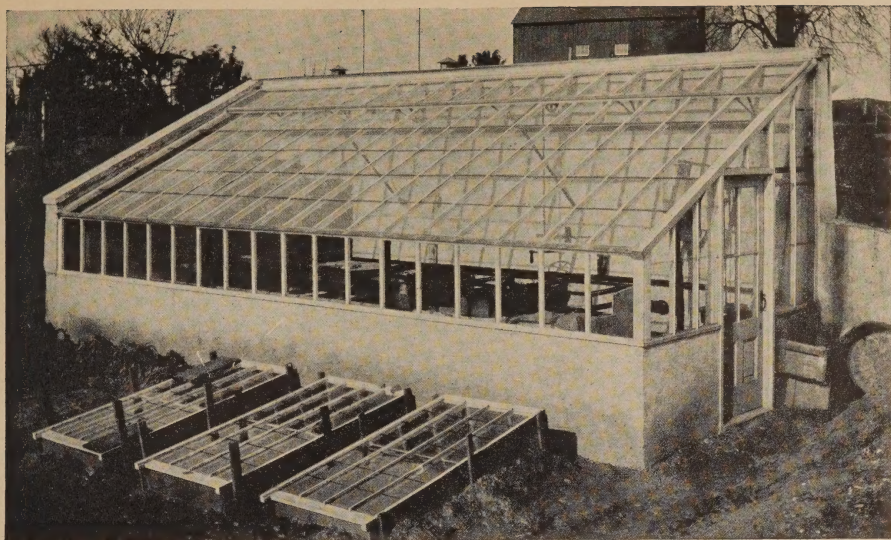


Figure 75—A well constructed concrete greenhouse.

Hot Beds and Cold Frames

Hot beds and cold frames are used to provide vegetables out of season and to rear early spring plants. Hot beds are set into the ground, with a flat sloping cover, all of glass.

The hot bed should be located where it will receive as much sun as possible, and face the south or southeast in the Northern States.

Construction—First, dig out the bed below frost line. Then build forms for a wall 4 inches thick, as described on page 15. Use a concrete mixture of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand and 5 parts gravel or crushed stone. The front wall—on the south side—should be 6 inches above the ground surface level. The height of the back wall depends upon the location of the bed, and the slope of the glass desired to catch the greatest

amount of the direct sun rays.

When concrete is poured, place bolts vertically at 2-foot intervals (see Figure 18, page 22) to fasten the frames on top securely to the concrete walls.

Hot house frames are made especially for these constructions, but an old window sash may be used. If you want to build a hot bed at low cost, use a window sash you have, and build the concrete walls to conform to it.

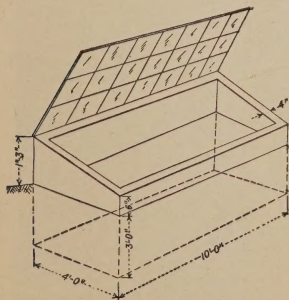
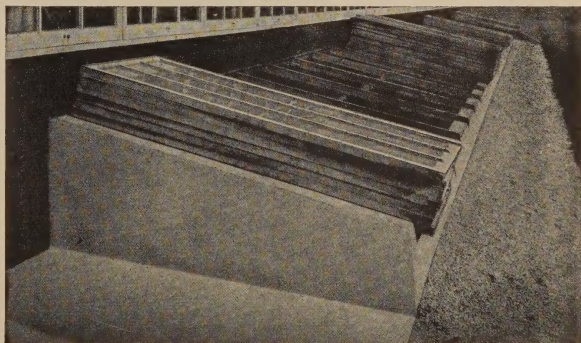


Figure 76—Details of cold frames built of concrete.



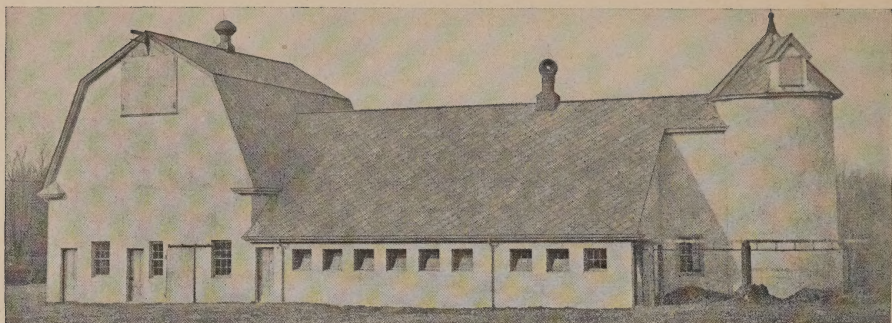


Figure 77—Reinforced concrete barn, dairy and silo. Main building 31 feet by 38 feet. Cow barn 50 feet by 38 feet.

Concrete in Barn Construction

The construction of barn foundations and floors of concrete has been explained on page 21. The use of concrete for the construction of the barn superstructure—at least up to the hay floor level—has advantages.

The concrete barn has many advantages over an all-wood structure for it is far more sanitary—having no wood to absorb odors or moisture. It is warm in

winter and cool in the summer. And it is a permanent fire-proof structure that has no painting or other upkeep charges, and does not rot or decay.

The model barn, with several different floor plans shown on the opposite page is designed to be constructed with foundations, floors and side-walls of concrete and the roof of wood.

The floor plans for the model barn of concrete are only suggestions of arrangement. You will note that

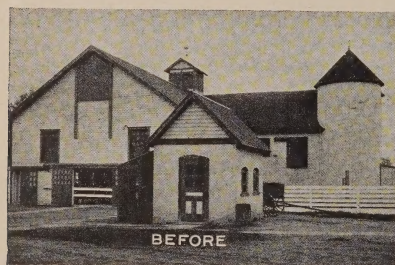
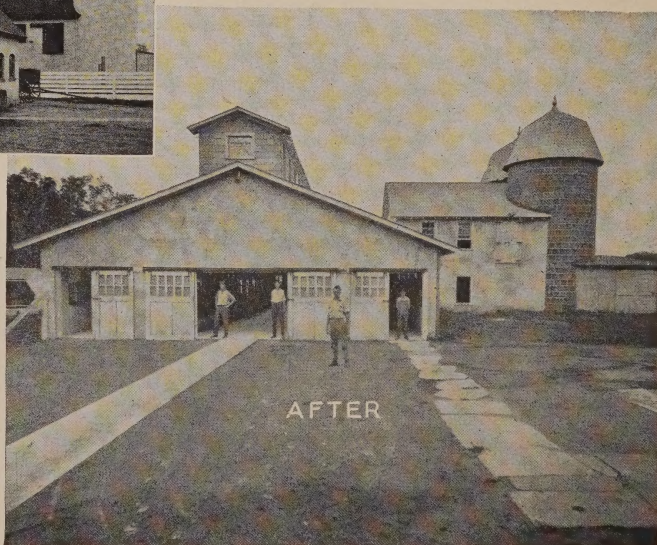


Figure 78—Barn at Vine-land, New Jersey, Training School—the illustration marked "before" shows frame structure which burned down in a single hour. Illustration marked "after" shows new concrete fireproof barn replacing the one burned down. Notice advantages of concrete sidewalk at left, as compared with flagging at right.



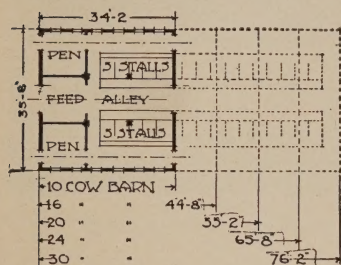
the typical plan is designed more especially for the dairy barn while the four smaller plans show how the one building can be divided to serve quite as well for a general utility barn on smaller farms where there are horses, cattle and carriages to be stored, together with one or two milch cows.

If the barn has two stories, the second floor may be constructed of reinforced concrete, thus adding much to the fireproof qualities of the barn. When a reinforced concrete self-supporting floor is used, it is necessary to have the walls of the barn constructed of concrete, concrete blocks or other masonry material.

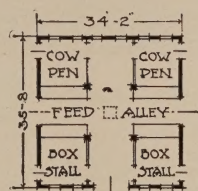
Proper design for a concrete structure of this size is essential for success. This is a job for an engineer or an architect—especially if you are building a good sized barn. Get expert advice on design—from a local engineer, architect or contractor.



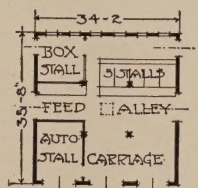
Figure 79—Another type of concrete barn.



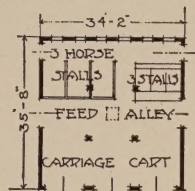
A TYPICAL PLAN



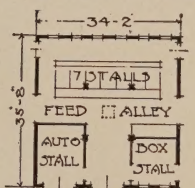
PLAN ARRANGED FOR
2 COWS 2 HORSES



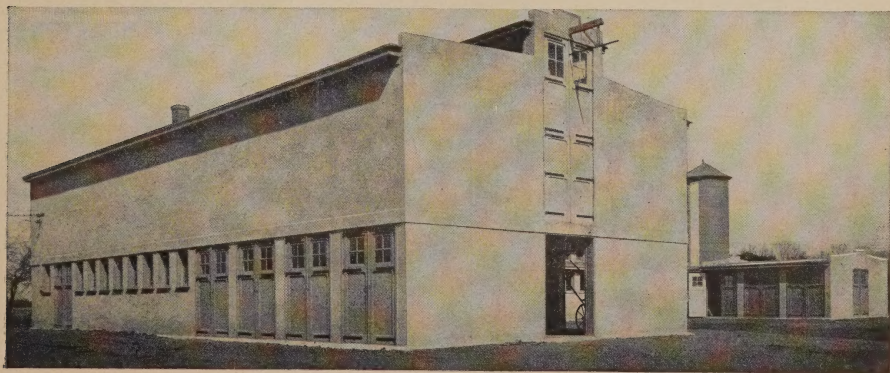
PLAN ARRANGED FOR
5 COWS - 1 HORSE + AUTO.



PLAN ARRANGED FOR
3 COWS - 3 HORSES



PLAN ARRANGED FOR
7 COW - 1 HORSE + AUTO



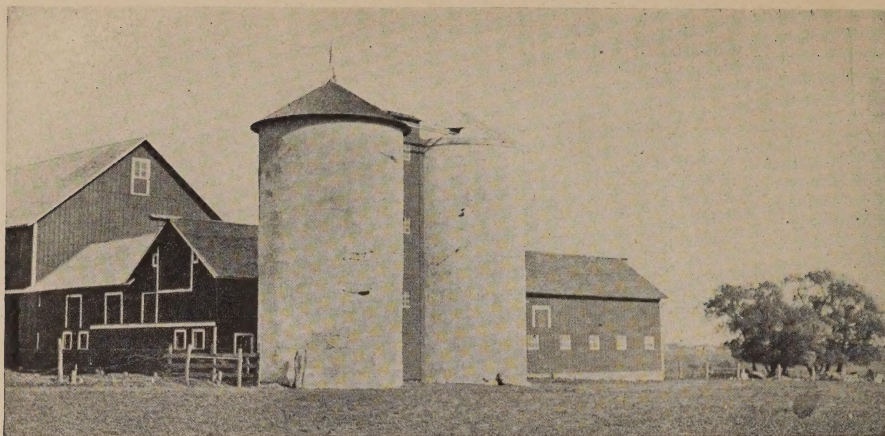


Figure 81—Twin circular silos of monolithic concrete. Notice the two types of roof.

Why You Should Have a Concrete Silo

A silo is indispensable to efficient farming. The experience of the last thirty years has demonstrated beyond doubt that both milk and meat can be produced more cheaply by feeding ensilage.

The silage crop is harvested at the proper stage of maturity and this green feed can be preserved in the silo for feeding during the cold winter months or through the droughts of summer. With a properly constructed silo the preservation of the silage may be so complete that the ensilage will keep from year to year or even for several years.

It has been said that the ideal silo would be a glass fruit jar, because it has smooth air-tight and water-tight walls without joints. Silos built of concrete

fulfill these requirements. They are vermin-proof, rust-proof, decay-proof, and fire-proof. They are recommended by government authorities and may be very economically constructed.

There are several different kinds of concrete silos: the monolithic or poured one-piece silos, the concrete block, the concrete stave, the stucco, and the pit silo. The construction will not be discussed here because we have a very complete book on the subject which we will be glad to send you on request.

In first cost, a concrete silo compares favorably with other forms of construction, with the added advantage that the first cost is practically the whole cost.

The table below and that on page 51 give silo capacities and herd silage requirements, etc.

Capacity of Silos in Terms of Stock to Feed

Diameter of Silo	Average Daily Feed	Number of Animals to be Fed from each Size Silo					
		Horses	500-lb. Calves	Stock Cattle	Beef Cattle	Dairy Cows	Sheep
10 feet	525 lbs.	48	44	26	21	13	175
12 "	755 "	69	63	38	30	19	252
14 "	1030 "	94	86	52	41	26	344
16 "	1340 "	122	112	67	54	34	446
18 "	1700 "	155	142	85	68	42	567
20 "	2100 "	191	175	105	84	53	700

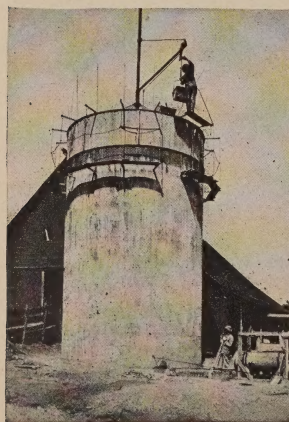


Figure 82—Monolithic concrete silo during construction.



Figure 83—Two well-built silos made of concrete staves. This type of silo is increasing in popularity.

The following table gives the number of cows in herd and tonnage of silage for both 180 and 240 days of feeding of 40 pounds of silage per cow; also acreage of corn estimated to fill the silo and the dimensions of the silo itself. The diameters given are such that at least 2 inches in depth of silage will be taken off daily.

An acre of land gives about 1 ton of silage for every 5 bushels of corn. If an acre yields 80 bushels, it will produce about 16 tons of silage. This table is based on a yield of 50 bushels or 10 tons of silage per acre.

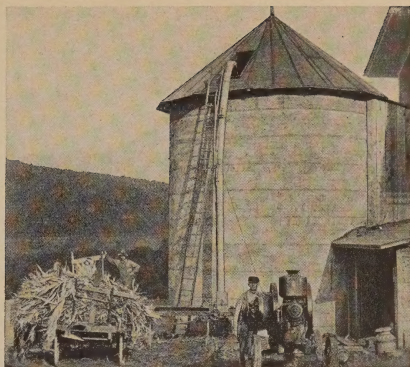


Figure 84—Filling a concrete silo. Concrete silos usually are proportioned so that they have a greater height with less diameter than shown in this picture.

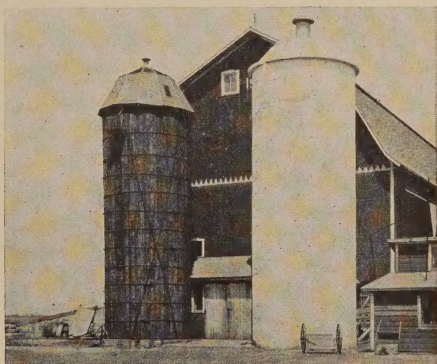


Figure 85—A study in contrasts. Notice the monolithic concrete silo at right with wood stave silo at left.

Size of Herd	Feed for 180 Days				Feed for 240 Days				
	Estimated Tonnage of Silage Consumed	Size of Silo		Corn Acreage Required at 10 Tons to Acre	Estimated Tonnage of Silage Consumed	Size of Silo		Corn Acreage Required at 10 Tons to Acre	
		Diameter	Height			Diameter	Height		
10 Cows	36 Tons	10 Feet	25 Feet	3½ Acres	48 Tons	10 Feet	31 Feet	5 Acres	
12 "	43 "	10 "	28 "	4½ "	57 "	10 "	35 "	6 "	
15 "	54 "	11 "	29 "	5½ "	72 "	11 "	36 "	7½ "	
20 "	72 "	12 "	32 "	7 "	96 "	12 "	39 "	10 "	
25 "	90 "	13 "	33 "	9 "	120 "	13 "	40 "	12 "	
30 "	108 "	14 "	34 "	11 "	144 "	15 "	37 "	14½ "	
35 "	126 "	15 "	34 "	13 "	168 "	16 "	38 "	17 "	
40 "	144 "	16 "	35 "	14½ "	192 "	17 "	39 "	19½ "	
45 "	162 "	16 "	37 "	16½ "	216 "	18 "	39 "	22 "	
50 "	180 "	17 "	37 "	18 "	240 "	19 "	39 "	24 "	
60 "	216 "	18 "	39 "	22 "	288 "	20 "	40 "	29 "	
70 "	252 "	19 "	40 "	25½ "	336 "	20 "	46 "	34 "	

Concrete for the Corn Crib

An important structure on the farm is the storage place for drying corn. The corn crib, as it is usually built, is the rat headquarters of the whole farm. The waste caused each year by rats and mice in corn cribs is enormous. By raising the crib a few feet on concrete piers, you will put one big obstacle in the way of the rats. A second important step toward conservation will be taken if you will build the floor also of concrete and this will make a much more permanent structure, and one far less likely to catch fire.

Easily Built

Piers—The piers upon which the crib is placed should extend underground below the frost line. Each pier should rest upon a base or footing at least two feet square and one foot thick. The mixture for these is 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone. See page 23 on the construction of piers and page 16 on forms for piers and foundations.

Under ordinary conditions, piers 8 inches in diameter, extending 18 inches below the ground and 30 inches above are satisfactory. Including footing, 5 2-5 cubic feet of concrete will be required for each pier, that is 1 bag of Atlas Cement, $2\frac{1}{2}$ cubic feet of sand, 5 cubic feet of gravel or crushed stone.

Figures 86 and 87 show an alternative construction with solid walls instead of piers, the walls being 8 inches thick.

Figure 86 shows how to construct a concrete floor and trench—the base and sides of which should be constructed (framed and poured) before work is begun on the main floor of the crib.

If you build the floor of concrete, make it 5 inches thick throughout.

Take every precaution to get a solid foundation. If the ground is not firm, dig deeper and fill the extra excavation with cinders or gravel packed to make a firm base.

See page 21 on building foundations and pages 32 and following for floor construction.

If the side walls are of wood, as in Figure 87, they should not be placed upon the piers or foundation walls for at least ten days after pouring.

Figure 88 shows a good construction for a corn crib. It has concrete floors and the side walls are of hollow concrete tile turned horizontally.

For general instructions on small buildings see page 42.

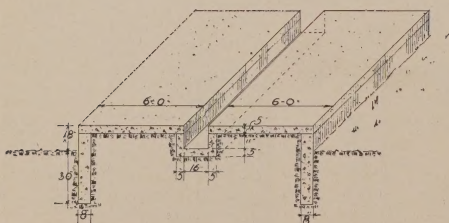


Figure 86—Section of concrete floor for corn crib.

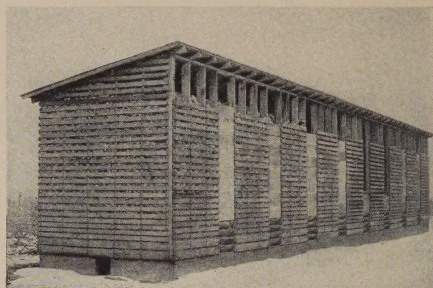


Figure 87—Corn crib with concrete foundation and floor.



Figure 88—Interior of corn crib built of concrete blocks.



Figure 89—Corn crib floors of concrete ready for superstructure.

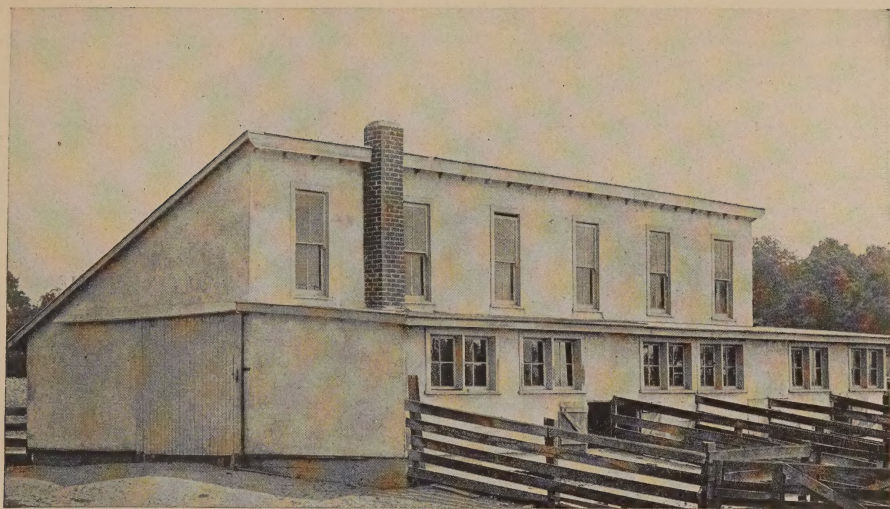


Figure 90—A concrete hog-house with wood roof.

Sanitary Hog Houses of Concrete

Hog raising has become very profitable for the farmer. It has been developed almost to an exact science, of which proper housing is a vital part. Early pigs bring the high prices and if you have a warm concrete house you can safely raise a February or March litter.

A concrete hog house can be made almost proof against hog cholera or other diseases. It is easy to clean—especially if all the corners are rounded—and the pens can be swept clean with water, flushed out with a hose, and easily disinfected.

The hog house should be on a well-drained site and should be built with the feed alley running east and west so that sun windows in the roof will face south and get the direct winter sun. The hog house should be so situated as to give direct access to the pastures—then the building can be used all the year round, for farrowing and for care of the young pigs in the late winter and spring, for feeding and shelter during the summer, and for fattening in the early autumn.

Foundation — The foundations are usually

10 inches thick and should be carried below the frost line, and if the earth is firm, the foundation trench can be filled with concrete up to the grade without the use of forms. Follow instructions on foundation forms in paragraphs 64-70, page 15.

The walls above the foundation should be 8 inches thick and 3 feet 6 inches high.

The partition walls forming the pens are of the same height as the outside walls, but are only 6 inches thick. The forms for these partition walls are the same as those for the outside walls.

After the outside walls are built the floor should be constructed, and this can be made 5 inches thick of a mixture 1 part Atlas Cement, 2 parts sand, and 4 parts stone.

See page 32—Barn and stable floors.

(Continued on page 55)

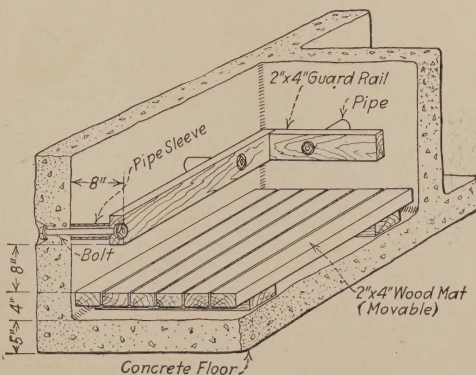


Figure 91—Sows nest, showing guard rail for protection of young pigs. Wood mat is covered with straw bedding.

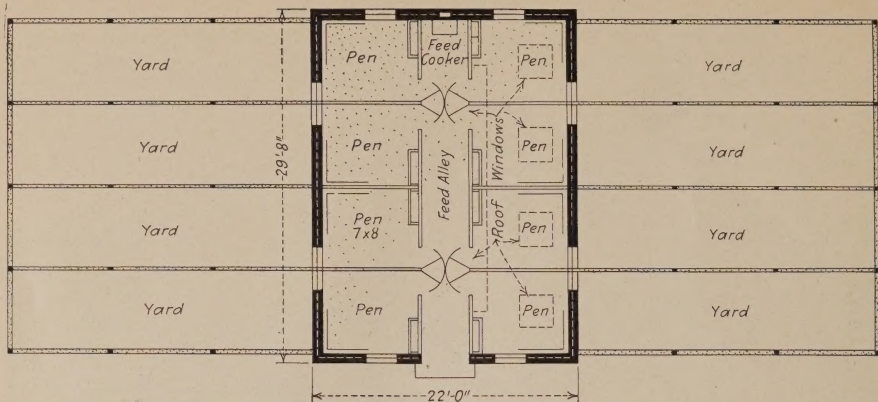
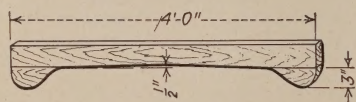


Figure 92—Floor plan of model hog-house.



Template to form Gutter

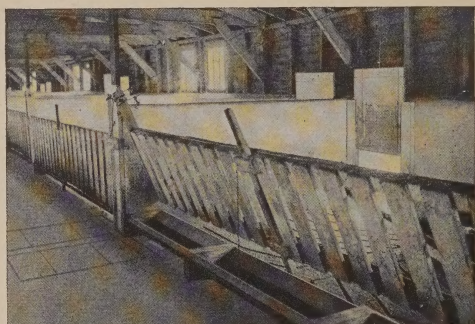


Figure 93—Above: Concrete hog-house pen with concrete feeding troughs.

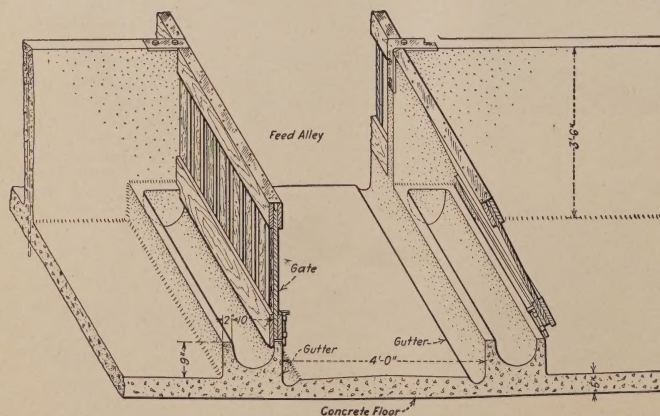


Figure 94—At left: Section of model hog-house showing partition walls, feeding troughs and gutters. Notice the swinging wood gate the same as shown in photograph above.

The pens should slope from the outside wall toward the alley-way down the center, and small openings should be left through the walls so that the pens can be easily drained when they are flushed out. The alley-way should have small gutters along each side.

Two doors are made in the walls of each pen, one leading to the alley-way and one from the other side of the pen to the yard.

Although concrete floors have proved entirely satisfactory for pens where bedding is used, some prefer to lay cork-brick or asphalt blocks in the corner of the pen where the sow makes her nest. Sometimes a movable wood mat is made of 2-by-4's, and the bedding is placed on this. This method is shown in Figure 91. A guard rail should be installed on both sides of the sow's nest as a protection for the young pigs, or otherwise there is danger of their being crushed against the walls as the sow lies down. This rail must be strongly bolted in place and should be spaced 8 inches from the wall. The bolts should be placed in the concrete when



Figure 95—Concrete block hog-house showing doorways to yard.

it is poured. There should also be 8 inches clearance space under the rail, so the young pigs can get under it.

An alternate method of construction of the pens is shown in Figure 94. In this construction the feed troughs are made a part of the floor and over them is fastened a wooden gate, which is hinged, as shown in the cut. By using this scheme the pigs can be prevented from getting at the

trough while it is being cleaned.

Figure 92 shows a plan of a hog house. The superstructure of this hog house may be made of wood, and it is built with a monitor roof so that the windows in the monitor face the south. By this arrangement the pens on both sides of the building receive the maximum amount of sun.

The yards should be enclosed with wire fencing on concrete posts (see pages 68 and following). The posts should be set in a curbing (see pages 35), which should go down at least $2\frac{1}{2}$ feet to prevent the hogs from digging under, as their rooting might undermine the posts.

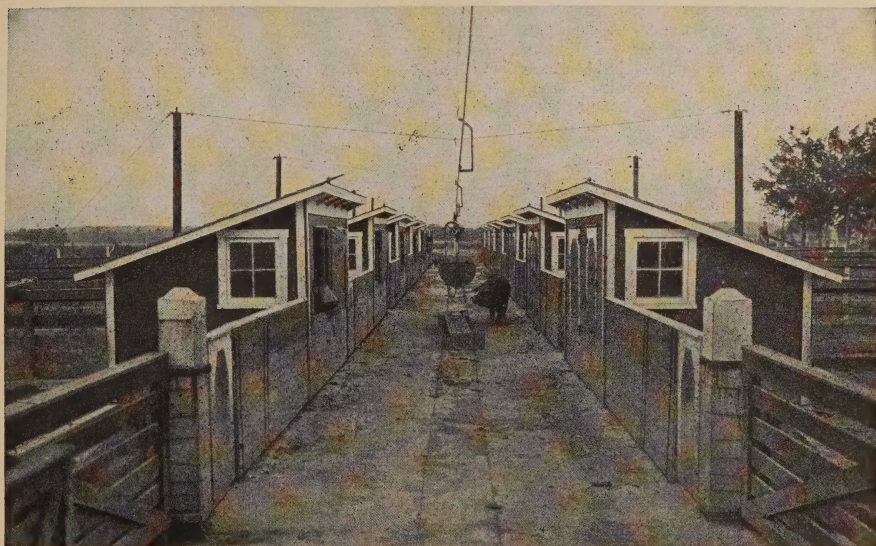


Figure 96—Concrete alleyway between two rows of individual hog-houses.

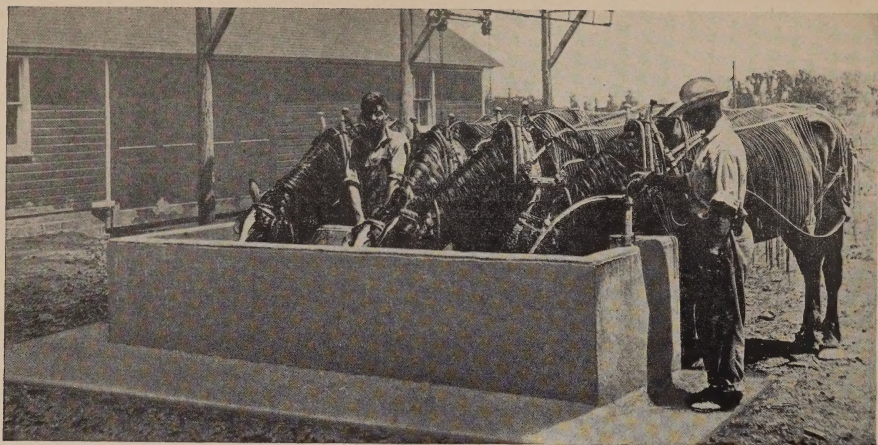


Figure 97—A concrete water trough with concrete pavement around the outside. This pavement prevents the ground from becoming muddy due to splashings from trough.

Concrete Watering Troughs

Concrete watering troughs are permanent, substantial and sanitary. They do not rot nor decay, nor do they require painting or other upkeep. Medium and smaller sizes can be easily and economically built with ordinary farm labor.

The foundation material under the tank must be firm and solid, as the tank is very heavy when full of water. If the soil is not firm and well drained, excavate 18 inches below grade and fill in with gravel or hard-burned boiler cinders well packed in 6-inch layers. Inlet and outlet pipe connections should be installed before the forms are constructed.

Forms—Figure 100 shows the method of constructing the forms. The outside forms are placed in position first and are well braced. The inside forms are made up and fitted ready for quick assembly in place at the proper time. The inside forms for the smaller size tanks

may be made in one piece if not too heavy to lift into place. Inside forms for the larger tanks can be made up with separate sides and ends, but be sure to have the different pieces fitted together before so as they can be assembled quickly and without delay.

Reinforcement—Quarter-inch round iron rods are used spaced 6 inches apart horizontally and 12 inches apart vertically (see Figure 100). When it is necessary to join ends of reinforcing bars they should be overlapped at least 12 inches and wrapped together with wire. Note that bars in floor of tank must be bent up at right angles, so as to extend into the wall as shown in the drawing. It is best to have the reinforcement wired together in proper place before starting to pour concrete. The reinforcing may be supported in proper position by a few pieces of brick or concrete block wired to the bottom bars.

Concrete Mixture—A rich mixture made with the greatest care is necessary for watertight results. Use 1 part Atlas cement, 2 parts sand and 3 parts of pebbles or crushed stone. The concrete should be of a "quaking" consistency. Be sure to use just as little water as possible in the mixing and still have the concrete so that it will work into place satisfactorily. Too much mixing water may result in a porous concrete. Pay particular attention to the method of depositing concrete as described on page 13.

Construction—First set the outside forms in position carefully braced and staked. Deposit concrete in the bottom of the form until it reaches the level of the top

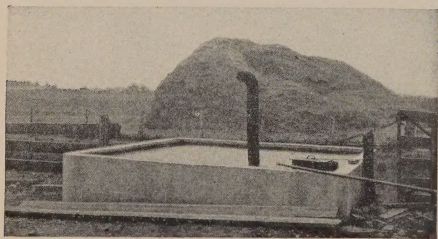


Figure 98—Concrete watering tank with water heater installed. This heater keeps the water from becoming too cold in the winter.

of the floor. Then immediately set the inside form in place which may be hung or supported on the outside form uprights, so that its lower edge rests on the top of the floor. Immediately continue pouring of the concrete until the wall forms are filled to the top. Smooth off the top edges of the walls and finish the top of the floor with a wood or steel float. Be sure to begin the concreting of the side walls as soon as possible after the floor so that no joint will occur between floor and walls.

The circular tank, shown in Figure 99, has some advantages although the forms are not so easily constructed, unless silo forms are available. In some cases, several farmers have co-operated in having a circular form built for joint use in constructing a tank on each of their farms. This is possible if the form is well built so that it can be used over and over. (Page 17.)

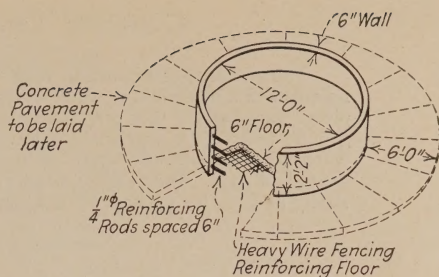


Figure 99—Diagram of circular watering trough showing concrete pavement to be laid later.

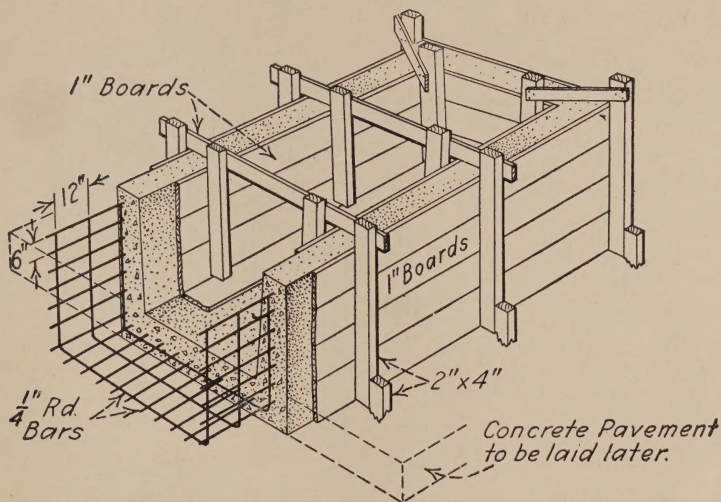
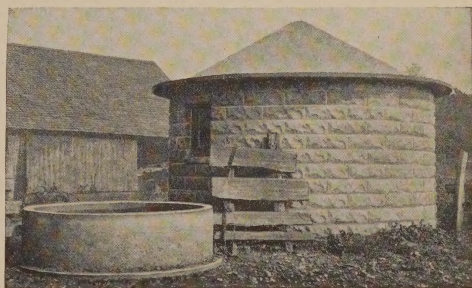


Figure 100—Forms for a rectangular water trough, see page 56 for construction. Figure 97 shows this type of tank after completion. Notice concrete pavement is laid after the tank is finished.

Figure 101—Concrete block pump house with concrete roof and circular concrete watering trough alongside. Notice that watering trough has a small concrete pavement around the outside, but this is not wide enough to be of any real use in preventing the ground from becoming muddy around the trough. Circular silo forms are convenient in constructing round watering troughs.



Concrete Tanks and Cisterns

The advantages of storing water on the farm are obvious. Concrete has no equal as a material for water tanks. Wooden and iron tanks rapidly go to pieces, especially if they are alternately full and empty. If they are built below ground their life is extremely short. They rust and decay and thus foul the water they contain. Concrete tanks are permanent and they keep the water sweet and pure. They are economical and easy to build—and they cost practically nothing for upkeep, for they don't have to be painted like iron or wood.

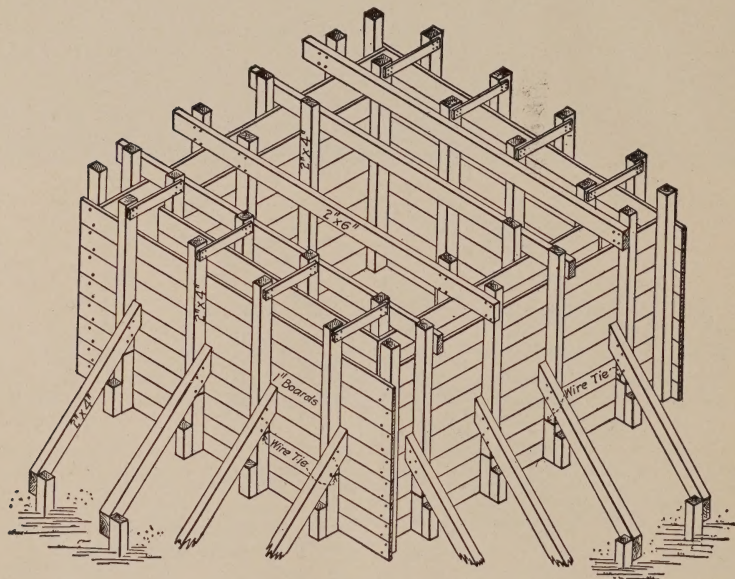


Figure 102—Forms for constructing concrete tank or cistern above ground.

How to Build Them

Forms—Tanks may be built square, rectangular or circular. The forms for a square or rectangular tank are shown in Figure 102. Build the inside forms first, supporting the upright studs on concrete blocks the thickness of the bottom of the tank. Of course, the boards of the inside form will only come down to the level of the top of the floor. The reinforcing of the floor and walls is then placed in position, and wired securely in place. The outside forms are built, and for the smaller size tanks the inside form can be supported by cross pieces as shown, using the studs of the outside forms to support the cross pieces. If this is done the blocks supporting the inside form can be removed, allowing the inside forms to hang from the cross pieces. Be sure to provide all pipe connections when building the forms.

Pouring—It is best to pour the concrete in one continuous operation to avoid joints, but if this cannot be

done, a construction joint can be made at the junction of floor and walls, as shown in Figure 104. See page 13 for directions on how to make a good construction joint.

Mixture—The concrete should be mixed 1 part Atlas cement, 2 parts sand and 3 parts crushed stone or pebbles, with only enough water to give a consistency sufficiently mushy to allow it to be placed. See page 13 on best way to deposit concrete for structures holding water. Avoid too much mixing water, as this might cause porous concrete. Amounts of materials required can be figured by reckoning separately the amount needed for floors and walls, as explained on page 11.

Further information—The tank shown in Figure 103 is 10 feet square, inside measurement, by 8 feet high. Such a tank will hold 6,000 gallons of water if filled to the very top. For any other size of tank write The Atlas Technical Department for further information on reinforcing and thickness of walls and floor.

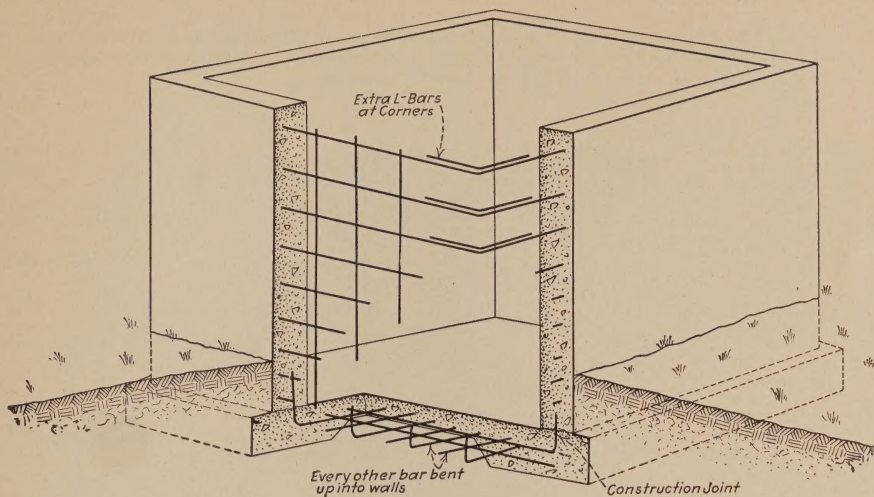


Figure 103—Drawing of concrete tank or cistern located partly above ground. Footings and floor are carried below ground sufficient to extend below frost line.

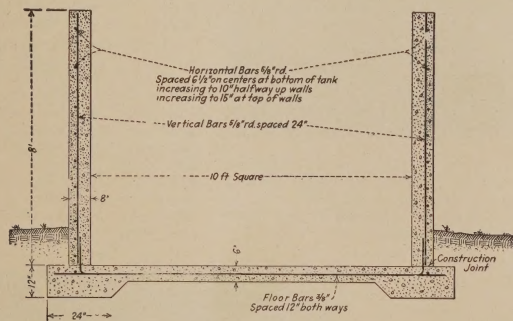


Figure 104—Above: Cross section of tank or cistern showing location of reinforcing. This reinforcing is located 2 inches from the outside surface of the tank walls. The reinforcing specified applies only to a tank 10 feet square or smaller and of the height given.

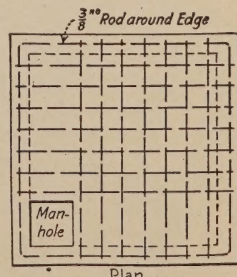


Figure 105—At right: Location of reinforcing in top of cistern cover. This reinforcing applies to a cover which supports only its own weight, without earth or other load resting on it.

Circular Tanks of Concrete

The main advantage of a circular tank is that less material is needed for a given capacity than for a square tank. It is not so easy to construct unless a silo form or some other circular form is available.

Reinforcing—The reinforcing rods for the bottom of a circular tank are laid at right angles to each other, in the same manner as the bottom of the square tank. The size and spacing are the same as for square tanks.

The reinforcing in the walls of circular tanks is mostly horizontal, and as the pressure against the walls is far greater at the bottom than at the top the reinforcing must be closer together near the bottom.

The vertical reinforcing is spaced the same for all sized tanks and is made up of $\frac{3}{8}$ -inch bars, 36 inches apart.

The horizontal reinforcing also is made up of $\frac{3}{8}$ -inch bars placed in the center of the wall. The varying spacing of this horizontal reinforcing is shown in Figure 108, which shows the reinforcing for a tank 15 feet high and 10 feet inside diameter. If the height of your tank is to be less than that shown, space the reinforcing as indicated in the upper part of the larger tank, for a distance as far



Figure 105—Circular water storage tank with wooden roof. The circular type of tank uses less material and less reinforcing than a square or rectangular tank. If forms are available it is easier to construct and gives the best results.

down as the entire depth of the smaller tank. That is, if the tank is 8-feet deep, the reinforcing will be like that of the upper 8 feet of the 15-foot tank.

Covers for tanks, cisterns and wells—The roof or cover for a tank, cistern or well is usually a flat reinforced slab, constructed the same as any other roof (see page 17 on roof forms), except that a 2-foot square manhole or trap-door opening should be left so that the forms may be removed and access had to tank at any time. This is done by nailing a square form or box with sloping sides 2 feet square and 6 inches high on top of the roof form at the place the manhole is to come. (See Figure 105, page 59.)

The forms for the flat roof are built inside the tank and supported by up-rights from the bottom of the tank. Another form, made of boards 5 inches high, should be built around the outside where the roof is to come. The reinforcing should be placed 1 inch from the bottom of the roof form.

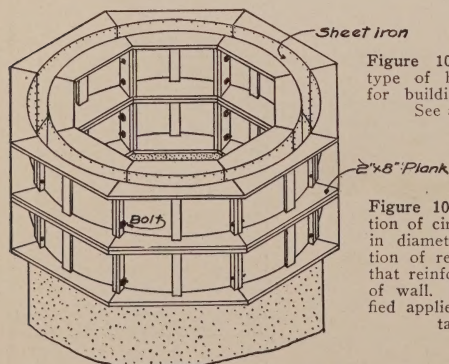
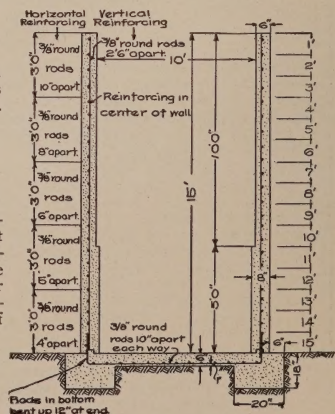


Figure 107—At left: One type of home-made forms for building circular tank. See also page 17.

Figure 108—At right: Section of circular tank 10 feet in diameter, showing location of reinforcing. Notice that reinforcing is in center of wall. Reinforcing specified applies only to size of tank given.



Reinforcing—For a slab 4 feet square or less, use $\frac{3}{8}$ -inch rods spaced 6 inches apart each way and a slab thickness of 5 inches. Slabs covering spans of from 4 to 6 feet should be 6 inches thick, and the reinforcing should be $\frac{3}{8}$ -inch rods spaced 5 inches in both directions.

Construct the cover of a mixture of 1 part Atlas Cement, 2 parts sand and 4 parts gravel or crushed stone. A slab 6 feet square and 6 inches thick will require 4 bags Atlas Cement, 8 cubic feet sand, and 16 cubic feet gravel or stone.

Well Platforms

A sanitary covering for the drinking water well is best secured by a concrete platform. It is comparatively inexpensive; it is permanent; can be made tight and strong; and will prevent the entrance of surface water or refuse water into the well.

Construction—First build a concrete curb on top of the well lining and high enough to prevent surface water from flowing into the well. Around this lay a pavement at least two feet wide to keep the earth around the well from becoming muddy. This is shown in the figure. Across the opening will be placed a slab of concrete. As this is unsupported it will have to be reinforced. The amount of reinforcing and its position are described on this page, under the description of covers for concrete tanks and cisterns.

It is preferable to build this slab on one side of the well, and after it has hardened sufficiently, skid it into place over the well. This method is shown in Figure 110. Timbers are laid so that the tops of them are level with the top of the well curb. On these timbers is built

a floor of boards with boards on edge for the side forms. This is the form for the slab. Leave a hole in the concrete for the well pipe. When the slab is moved over the well it should be bedded in place with cement mortar mixed in proportion of 1 part Atlas Cement and 3 parts of sand. Only a slight amount of mortar will be required.

Mixture—The concrete should be mixed in the proportion of 1 part Atlas Cement, 2 parts sand, and 4 parts broken stone or gravel. The concrete should be finished with a wood float and allowed to harden for at least 10 days before it is moved over the well and the pump placed on the platform. A slab 6 feet square and 6 inches thick will require 4 bags of Atlas Cement, 8 cubic feet sand, 16 cubic feet gravel or crushed stone.



Figure 109—Well platform of circular shape with small pump in center.

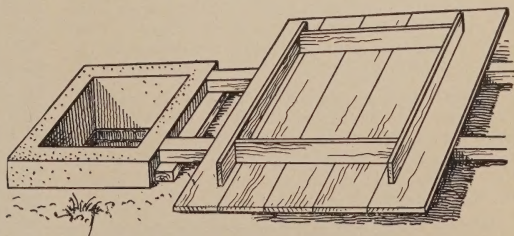


Figure 110—Method of constructing a square well cover. Notice that cover is built on platform and then moved over into its place on top of the well. Well covers are quite heavy and should be planned so that they can be easily moved into position.

Concrete Manure Pits

The most valuable parts of manure for fertilizer are the soluble parts. Manure stored in the old way under the barn or in the barnyard is exposed to the rain, which dissolves these parts and carries them into the ground where they are wasted.

A concrete manure pit preserves the full strength of the manure, and this saving more than pays for the cost of the pit.

The U. S. Bureau of Animal Industry (Department of Agriculture) says that "one load of manure from a concrete pit is worth $1\frac{1}{2}$ to 2 loads of manure as usually stored."

The whole trend of the times toward more thrift and a more careful conservation of natural resources—with the greatly increased cost of artificial manure—points to the adoption of concrete manure pits.

A concrete pit may be easily roofed over (Figure 111); and this will largely eliminate the nuisance of flies whose chief breeding place is in manure piles. Complete protection from flies and the diseases they carry may be secured by screening in the posts of a pit like that shown in Figure 111, with good strong mosquito netting. This will cost something, at the start—but will be well worth the money. Providing a roof over the pit also reduces the action of rain in diluting and weakening the fertilizing elements in the manure. Sloping board covers, hinged in sections, may be used in place of an elevated roof for smaller pits.

Figure 115 shows a pit with inside measurements 24 feet by 19 feet, by 2 feet 8 inches deep, with floor 6 inches thick, and walls 10 inches thick at the bottom and 6 inches at the top. Across one of the ends is a gutter with opening for outlet to carry off liquid manure. This liquid is often drained into a concrete cistern or sump pit as it is a valuable fertilizing element. It can be pumped out and sprinkled over the land or over the manure.

Excavate about $2\frac{1}{2}$ feet deep, to allow for a 6-inch floor and yet bring the walls above ground. Slope the base of your excavation toward the end where the drain is to be so that one end is about 6 inches lower than the other and the liquid will drain to this end. Take every possible precaution to assure the storage of the valuable liquid manure.

Forms—If the ground is very firm you will need outside forms only above ground. Build the inside wall forms with a slight tilt as shown in Figure 116, to make the wall wider at the base than at the top. Use a template to shape the gutter at one end, when the concrete has been poured and is still soft and easily shaped.

Mixture should be 1 part Atlas Cement, 2 parts sand and 4 parts gravel or crushed stone.

Materials required—A concrete manure pit the size shown constructed of a 1:2:4 mixture will require 93 bags Atlas Cement, 186 cubic feet sand, 372 cubic feet gravel or crushed stone.

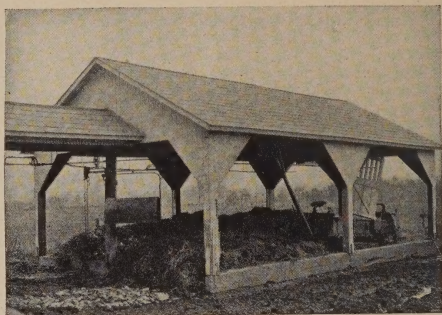


Figure 111—Concrete manure pit with wood cover.

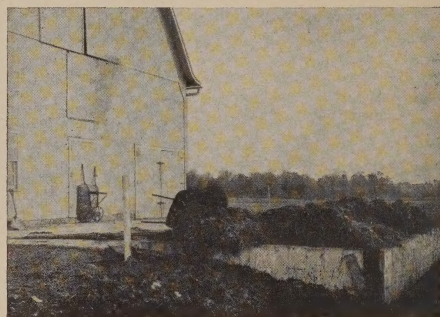


Figure 112—Concrete manure pit adjoining barn.

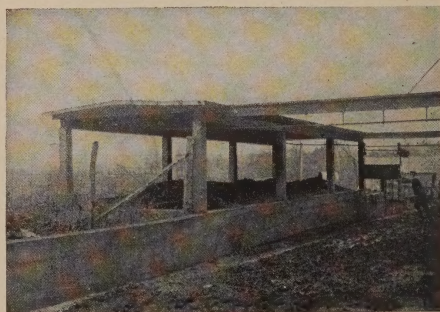


Figure 113—Another type of covered concrete manure pit.

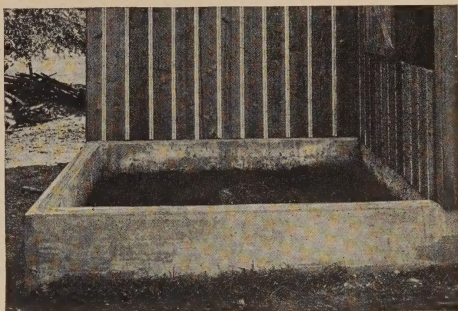
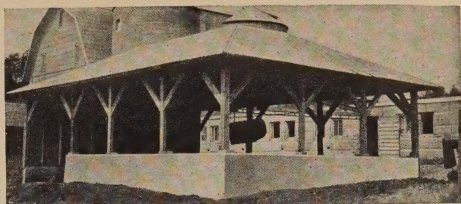


Figure 114—Three types of concrete manure pits. Notice convenient arrangement of manure carriers in pit shown above. It would be better if this pit were covered to prevent washing of rain,

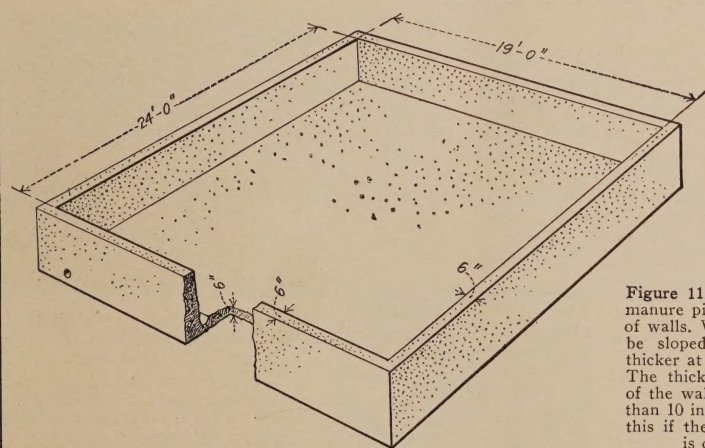


Figure 115—A drawing of manure pit showing thickness of walls. Walls should always be sloped so that they are thicker at bottom than at top. The thickness at the bottom of the wall should not be less than 10 inches, and more than this if the height of the wall is over $3\frac{1}{2}$ feet.

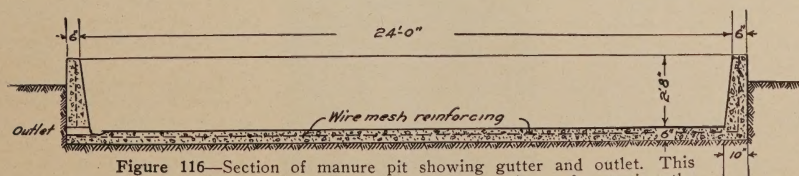


Figure 116—Section of manure pit showing gutter and outlet. This outlet should be connected to a sump pit or cistern for storing the liquid manure.

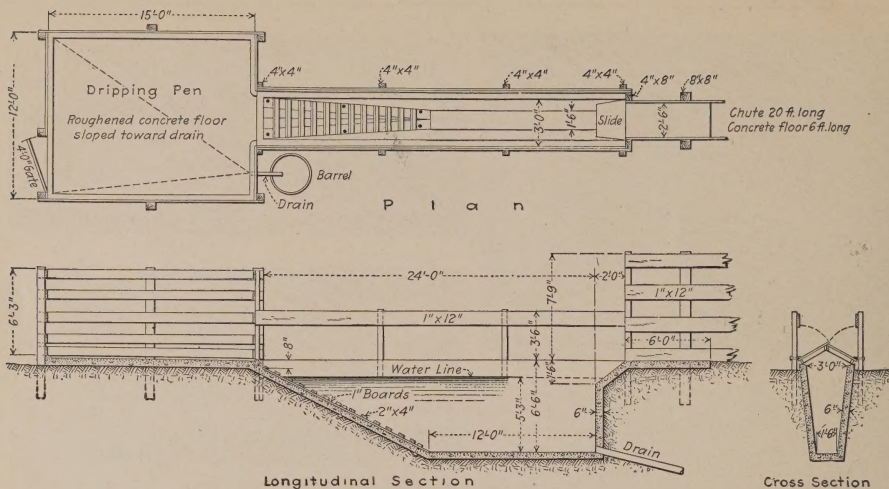


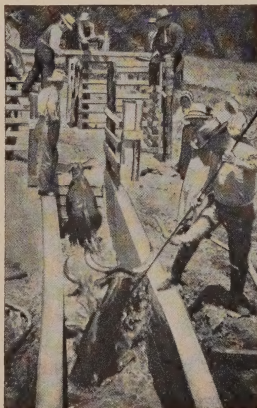
Figure 117—Plan and section of concrete dipping vat. At right is shown cross section with wooden covers for preventing dilution by rain water.

Dipping Vats and Tanks

To be in good health, cattle must be free from lice, ticks, fleas, etc. These parasites irritate the cattle, keep them from fattening, and in some instances carry dangerous diseases to them. Dipping the cattle in a vat filled with a chemical solution that will kill these pests is absolutely necessary. Concrete is the best material for such a vat, because it is permanent, tight and not affected by powerful chemicals.

Construction—The tank should be so constructed that the cattle, on entering, will slide off into the solution. The dipping tank is made of concrete, with a chute at one end to guide the cattle into the tank and a dripping pen at the other end which has a concrete floor sloped so that the solution which drips off the cattle will run back into the tank (or into a barrel) and be saved. One end of the tank has a short slope that plunges the cattle under the solution, and the other end has a gentle slope with a corrugated or cleated floor so that the cattle can easily climb out. Complete dimensions are given in Figure 117.

Excavate 1 foot longer and 1 foot wider than the inside measurements given. Make the bottom of the excavation 6 inches deeper. Give the sides



and ends of the excavation the slope shown in the plan.

Build the forms for the walls as explained on page 15 and allow for walls and floor 6 inches thick.

Reinforce the walls and floor with woven wire fencing, placed in the center of both walls and floor and lapped at the corners.

As the solution will be used several times, it is best to build a cover to prevent rain from diluting the solution.

The mixture should be 1 part Atlas Cement, 2 parts sand, 4 parts gravel or crushed stone.

Quantities required—The tank shown will require 60 bags of Atlas Cement, 120 cubic feet of sand, and 240 cubic feet of gravel or crushed stone. This includes the pavement for the dripping pen and entrance chute.

Hog Wallows of Concrete

The modern farmer is learning the necessity of taking good care of his hogs—keeping them clean and well—and realizing on it in ready money when it comes time to kill. The idea that anything is good enough for a hog and that he loves filth and that he needs dirt—all that has been exploded. See page 53 on hog houses.

If you don't give a hog a place to cool off in clean water in the summer-time, he will try to build one himself of mud. The hog wallow is best built of concrete, because then it will be permanent and sanitary. If you possibly can, build it in connection with the hog house or feeding floor. See pages 53 and 38.

Construction—The hog wallow, shown in Figure 119, is 8 feet wide by 12 feet long outside, and 18 inches deep. Give one end a slope with a corrugated surface so that the hogs can climb out easily; or you can fasten a couple of planks together, lay them up the slope and put cleats across them a few inches apart to give the hogs a foothold. A pavement is laid in front of the incline, so the hogs will not form a mudhole when they come out. The plan provides for a drain and 4-inch discharge pipe, so that the wallow can be drained and cleaned out.

Provide a solid foundation by filling and packing if the soil is not naturally firm and hard. Read page 29 on excavation, drainage and fill for pavements.

Build the forms for the walls as shown on page 15. Build the walls and floors 6 inches thick as shown.

For reinforcement, see pages 56 and 57.

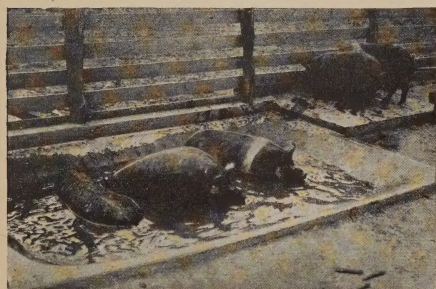
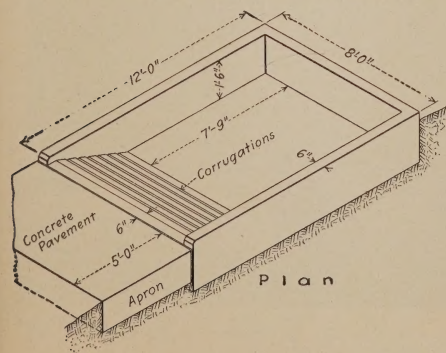


Figure 118—Two types of hog wallows, one small and one large. Notice that large wallow is placed adjacent to watering trough so that overflow from watering trough can discharge into hog wallow.



The concrete pavement and apron shown in Figure 119 will be a little extra bother to build—but they will be well worth it. They will keep the ground around the wallow from being muddy and miry—which is bad for the hogs; and they prevent the hogs from rooting under the walls—which is disastrous to the walls.

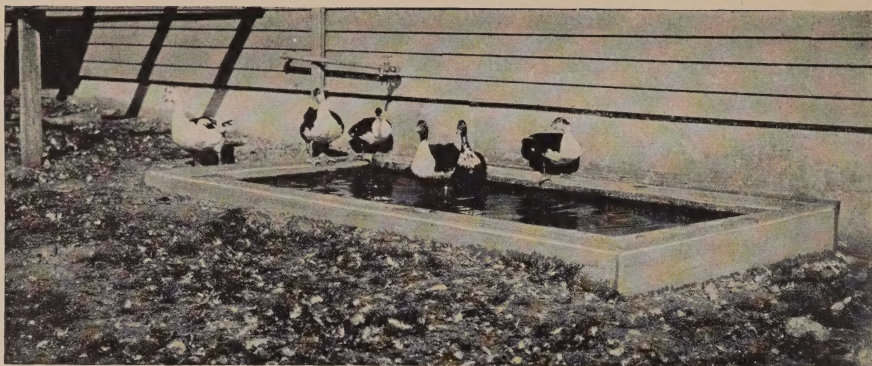
Mix the concrete in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

Reinforce the walls and floor with woven wire fencing, which should be placed in the very center of the walls and laid on top of 3 inches of concrete in the floor—with another 3-inch layer on top. Be careful to select the aggregate carefully and spade the concrete carefully in the forms to get it watertight.

Quantities—The tank shown in Figure 119, with walls 3 feet deep, will require 27 bags of Atlas Cement, 54 cubic feet of sand, and 108 cubic feet of gravel or crushed stone.



Figure 119—Suggested design for hog wallow 7 feet by 11 feet, inside dimensions. Some hog wallows are provided with sloping walls on all four sides.



Duck Ponds

A duck pond is desirable on almost every farm, not merely because it permits raising ducks where there is no stream, but where there is a stream the pond keeps the ducks "at home."

The same kind of a pond can be built for ornament, or where there are children, for a wading pool.

A concrete pond is easily built, economical and permanent. General directions for walls and floors will tell you how to build a pond of the sort illustrated.

Use a 1:2:4 mixture with aggregates carefully graded,

and tamp and spade the concrete well. A pond 8 feet by 12 feet with walls 2 feet deep will require 20 bags of Atlas Cement, 40 cubic feet of sand and 80 cubic feet of gravel or crushed stone. Two men could easily build it in 2 days.



Concrete Dams

In building dams there are many things to be taken into consideration such as conditions of foundation, amount of flow, ice pressure, etc. A dam must resist leakage, overturning and sliding. Concrete is the best material for a dam—it is permanent, can easily be made water-tight, and is simple in construction.

For dams more than 2 feet high, a special design is required, based upon full knowledge of conditions and made by an engineer who should also supervise its construction.

Construction of small dams—Where it is possible, construct a temporary trench to carry the water round the dam while you are building it. If this cannot be done, run the water through a wooden trough in the middle of the dam by means of a temporary diversion dam constructed above the temporary dam site. After you have constructed the dam on each side of the sluice, you can carry the forms across the opening and complete the construction in this section. Be sure that your forms are heavy and tight.

After diverting the stream through the sluiceway, exca-

vate for the foundation of the dam, slightly wider than the width of the dam to be built, carrying it about 3 feet below the bed of the brook; or, if the ground is soft, deep enough to reach good hard bottom.

In the construction of concrete dams you should use a mixture of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone. Place the concrete continuously, if possible. If it is impossible to do this, precautions must be taken to get a proper bond between different batches of concrete deposited. (See page 19.)

The forms and bracing on the down-stream side of the dam should be left in place for two or three weeks, while the forms on the up-stream side may be removed in three or four days under favorable conditions.



Photograph by Courtesy of Cecil A. Shew.

Figure 120—Small concrete dam with spillway.

Swimming Pools

A concrete swimming pool is a great source of pleasure and comfort during the hot summer months. It should be located where it can be drained easily and the intake supply should be carefully planned—for a tank large enough to be adequate for swimming requires quite a quantity of water. The tank should not be less than 15 by 40 feet and 3 feet deep at one end to 6 or more at the other end. The standard size pool is 20x60 feet.

The forms required are similar to the foundation forms described on page 15. The mixture for the concrete should be 1 part Atlas Cement, 2 parts of sand, and 3 parts of gravel or crushed stone. Care should be used depositing the cement. Thoroughly puddle it in the forms so a dense and waterproof wall will be ob-

tained. See page 19 on waterproofing.

Fuller information on swimming pools and the necessary reinforcing is given in a booklet on the subject which is yours upon request. Swimming pools should be constructed by a competent contractor who is experienced in reinforced concrete work.

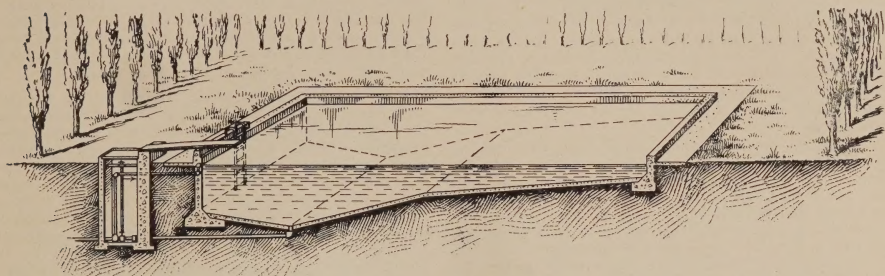


Figure 121—Section showing construction of concrete swimming pool. All swimming pools must be reinforced. For the sake of clearness reinforcing is not shown in this drawing.

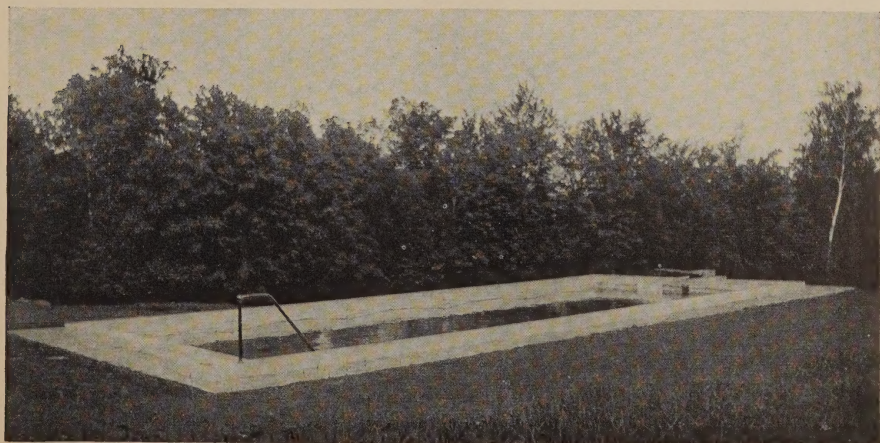


Figure 122—A concrete swimming pool made with Atlas White Portland Cement in accordance with the design shown above.

Concrete for Fence Posts

Concrete fence posts are coming more and more into general use. This is due not only to the scarcity and high price of good straight wood posts, but to the permanency of the concrete post, its greater strength and more pleasing appearance.

When a wooden post rots, it allows the wire of the fence to fall to the ground where it quickly rusts and is lost. The concrete post always keeps the wire in proper position and ensures a permanent and safe enclosure for the field. Weeds always grow along fences,

where it is extremely difficult to mow them either by machine or by hand. If you have concrete fence posts it is easy and entirely practicable to burn the land over. Fire will not harm concrete posts although it destroys wooden ones.

How to Build Posts

Size and shape—The length of the post is determined by the height which is desired above ground.

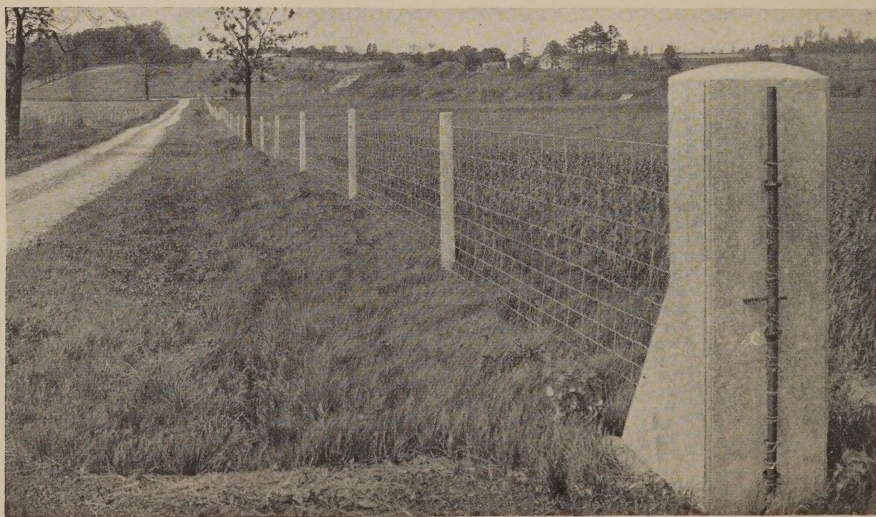
Concrete fence posts may be either straight or slightly tapering. An ordinary size is 5 or 6 inches square at the bottom and 4 or 5 inches square at the top.

Forms—Posts may be built separately—that is, each in a separate form laid on the ground—but it is much cheaper to build forms for a number of posts so that several can be molded at the same time, and then the forms can be used for another set as soon as the concrete has hardened.

Figure 123 shows a combination form that can be easily taken apart to take out the posts and to clean the forms. This form is for posts 5 inches square at both ends and 6 feet long. Choose a place where the posts can be left undisturbed for at least ten days. Lay 4-by-4-inch sills 4 feet long 2 feet apart, as in Figure 123, and nail a floor of 1-by-6-inch dressed lumber on the sills, making the floor 8 feet long and 4 feet wide. Make a frame of dressed 2-by-4-inch boards with the end pieces fitting into notches in the side pieces. The partitions of 1-by-4-inch dressed boards fit into notches

in the end pieces. Nail triangular stop blocks at the corners and keep the frame in position while the posts are being made by driving wedges against the stop blocks. To fill the form once, that is to make 4 posts of the size given (using a mixture of 1 part Atlas Cement, 2 parts sand, 3 parts gravel or crushed stone not larger than $\frac{3}{4}$ -inch) will require about 1 bag Atlas Cement, 2 cubic feet sand, 3 cubic feet stone or gravel.

Figure 124 shows a combination form for the posts each 7 feet long and tapered from a base 6 inches square to a top 4 inches square. In this form a level surface is made as before, by nailing dressed lumber on sills to form a smooth, tight surface. To make the posts tapering, it will be necessary to make the partitions wedge-shaped and to place wedge-shaped pieces in the bottom of each mold. The dimensions of these pieces are shown in Figure 124. After the pieces are assembled between the two end-boards, they are tightened by the two wedges. The tops of the posts will then be on the same level so that they can be easily finished with a trowel. For 10 posts of this size, allow $2\frac{1}{2}$ bags Atlas Cement, 4 cubic feet sand, and 8 cubic feet gravel or stone.



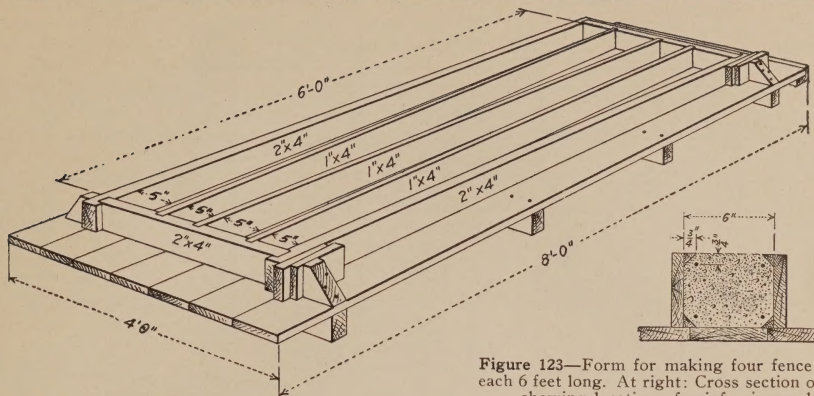


Figure 123—Form for making four fence posts, each 6 feet long. At right: Cross section of form showing location of reinforcing rods.

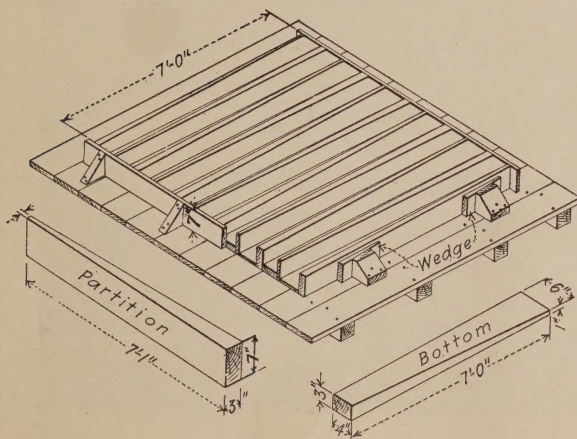


Figure 124—Form for making ten posts of tapering section. At right: Method of fastening fence wire to concrete posts. In this type of tie, soft galvanized iron wire is twisted around the fence wire as shown.

If large quantities of posts are to be made, it is usually cheaper to use steel molds. These can be bought through building material dealers. Probably your local dealer sells them. If not, write us for names and addresses.

Reinforcing is necessary in all concrete fence posts— The size of the reinforcing will depend upon the size and length of the post. See table on page 70. The reinforcing bars must be in the corners as shown in Figure 123. Use round rods and not wire, as one wire in a corner is not strong enough and if several are used it is impossible to keep them in place. The reinforcing can best be kept in place by the simple spacers made of wire. First place 1 inch of concrete and then place two rods on top of the concrete. Then fill within 1 inch of the top and place the other two rods.

Proportioning, placing, etc.—The concrete for fence posts should be made in the proportions of 1 part Atlas Cement, 2 parts sand, and 3 parts gravel or crushed stone. Use stone that is not more than $\frac{3}{4}$ -inch in diameter so that it will go around the reinforcing

properly. Tap the forms with a hammer to distribute the concrete around the reinforcement and give a smooth surface. The exposed face of the concrete may be finished with a steel trowel, but if the concrete is properly placed it will not be necessary to give the posts any additional finish.

Like all small masses of concrete, fence posts must be carefully protected until they are hard. Keep them moist by sprinkling for at least ten days, and then store them out of the sun until they are at least a month old before setting in place in the ground.

Fastening wire—There are several methods of fastening woven wire fencing to the post. You can put eye-bolts or staples in the concrete while it is soft or leave a hole through the post, but this is likely to weaken the post. The best method is to wrap a wire around the three sides of the post that are not touched by the fencing wire, and twist it around the fencing wire as shown in Figure 124.

Materials Required for 10 Posts, Different Sizes

Length	Top	Bottom	Cement	Sand	Pebbles	Reinforcement
6 ft. 6 in.	3 in. sq.	5 in. sq.	2 bags	4 cu. ft.	6 cu. ft.	40 1/4-inch round rods —4 for each post.
7 ft.	"	"	2 "	4 "	6 "	
7 ft. 6 in.	"	"	2 1/5 "	4 2/5 "	6 3/5 "	
8 ft.	"	"	2 1/3 "	4 2/3 "	7 "	40 5/16-inch round rods —4 for each post.
6 ft. 6 in.	4 in. sq.	5 in. sq.	2 1/3 "	4 2/3 "	7 "	
7 ft.	"	"	2 1/2 "	5 "	7 1/2 "	
7 ft. 6 in.	"	"	2 3/4 "	5 1/2 "	8 1/4 "	40 3/8-inch round rods —4 for each post.
8 ft.	"	"	3 "	6 "	9 "	
6 ft. 6 in.	5 in. sq.	5 in. sq.	3 1/2 "	7 "	10 1/2 "	
7 ft.	"	"	3 4/5 "	7 3/5 "	11 2/5 "	
7 ft. 6 in.	"	"	4 "	8 "	12 "	
8 ft.	"	"	4 1/3 "	8 2/3 "	13 "	

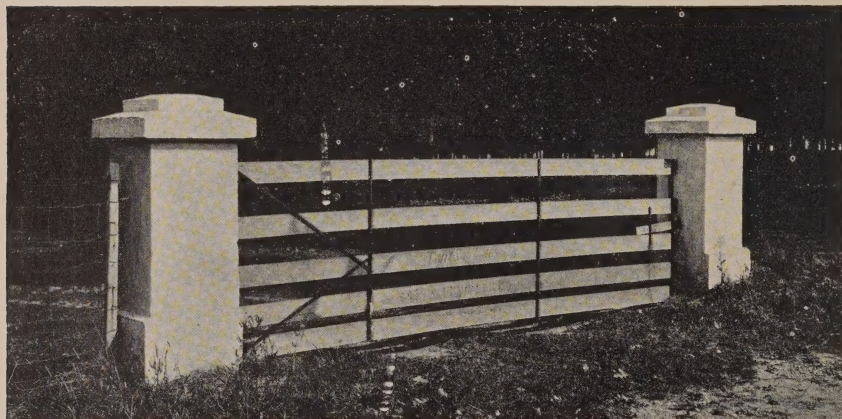
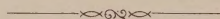


Figure 125—An example of sturdy and ornamental concrete gate posts. Gate posts should always be built of ample size, not because excessive strength is required, but for sake of appearance.

Corner Posts and Gate Posts

Corner posts and gate posts are subject to far greater strains than line posts. Corner posts must withstand practically the entire pulling strain of the fence from two directions. The gate posts have to withstand the strain of the fence and also of the gate. These posts must, therefore, be much heavier and be more strongly reinforced than the line posts.

Corner posts on account of their size and weight, are best made in place. Excavate a hole for the part which is below ground, and build a form as shown in Figure 12 for the section above ground. Place the reinforcing—be sure it goes down to the bottom of the hole—and pour the concrete from the top.

Bracing heavy posts—Even though corner posts and gate posts are very heavy, it is usually wise to brace them in the direction of the pull. These braces are best made out of concrete, so that they will be as lasting as the posts. See Figures 127 and 129.

The braces should always extend in the direction of

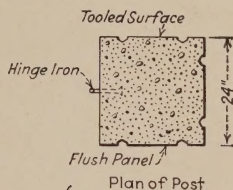
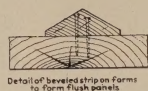
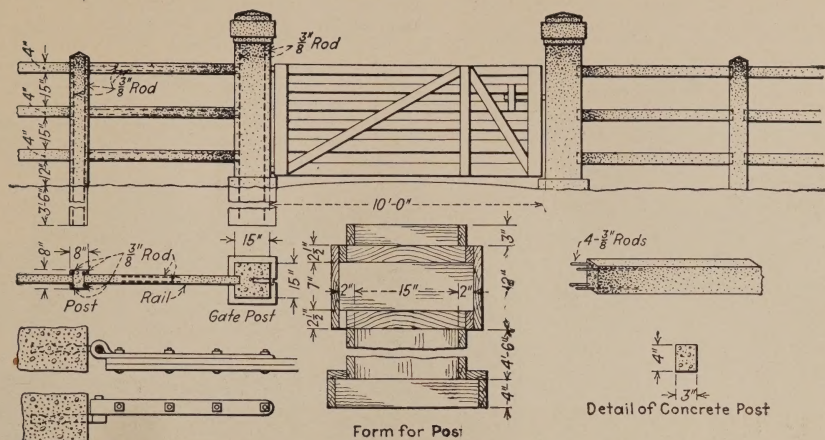


Figure 126—Two designs for building concrete gate posts. At the top of the page is a design having ornamental cap with concrete rail fence connecting with the gate post. This design could also be used with wire fencing or any other type of fence. Below is shown plan of plain gate post with panels outlined with beveled strip. The flush panels may be given a special finish as described on page 18.

the strain from fencing. A simple method of making them is to use one of the small line posts set with one end in the corner post and the other in the ground, resting against a block of concrete in the ground.

Gate posts can be given a handsome appearance by simple ornamentation, such as panels in the sides and ornamental tops. These panels are made by nailing boards to the inside of the forms. See Figure 126 on the preceding page.

Hinges for gates can be attached to the posts in several ways; rods can be placed through the forms and removed before concrete has fully hardened so that holes will be left, and the hinges bolted through the post; or one end of the hinge, with a washer in the end, may be placed in the soft concrete as shown in Figure 126. On a circular post adjustable hoops for holding hinges may be placed as in Figure 128.

If hinges are set permanently in the concrete, they should be of non-corrosive metal or else galvanized. Otherwise a rusted hinge might be troublesome of replacement.

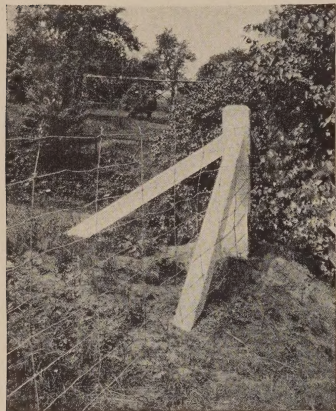


Figure 127—A corner post with two concrete diagonal braces.



Figure 128—One method of fastening gate to a gate post by means of strap-iron hinges.

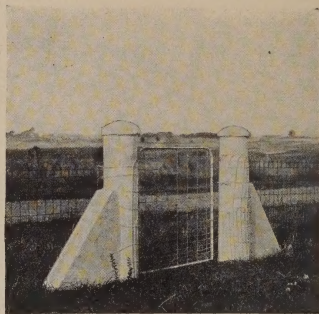


Figure 129—Another design for concrete gate posts. Notice the braces for resisting pull of wire fencing.

Materials Required for Four Corner Posts, Different Sizes

Length	Size	Cement	Sand	Pebbles	Reinforcing
8 feet	6 in. sq.	2 bags	4 cu. ft.	6 cu. ft.	{ 16 1/2-inch round rods—4 for each post.
8 feet	7 in. sq.	2 4/5 "	5 3/5 "	8 2/5 "	
8 feet 6 in.	"	3 "	6 "	9 "	{ 16 5/8-inch round rods—4 for each post.
8 feet	8 in. sq.	3 3/5 "	7 1/5 "	10 4/5 "	
8 feet 6 in.		4 "	8 "	12 "	{ 16 3/4-inch round rods—4 for each post.
9 feet		4 1/5 "	8 2/5 "	12 3/5 "	
8 feet	10 in. sq.	5 4/5 "	11 3/5 "	17 2/5 "	{ 16 3/4-inch round rods—4 for each post.
8 feet 6 in.		6 1/5 "	12 2/5 "	18 3/5 "	
9 feet		6 2/5 "	12 4/5 "	19 1/5 "	

Concrete Posts for Various Uses

For any sort of post which can be made of wood, concrete can be used and it will have the advantage of being stronger, more permanent, of better appearance, and will require practically no attention or care—provided only that the concrete posts are made carefully of well chosen aggregates and that the posts are properly cured and set.

The possibilities of concrete in this direction are manifold and various. We are constantly hearing of

some new use for concrete devised by an ingenious farmer. You will probably think of other sorts of posts besides those mentioned below which can be built of concrete.

Hitching posts are easily made of concrete and are similar to fence posts. A ring is attached to them either by leaving a hole through the post near the top, or by placing an eyebolt in the top while the concrete is still soft.

Mail-box posts of concrete are permanent and ornamental, and give an air of dignity to the farm. They are constructed like fence posts. Two different types are shown in Figure 130. Ask your postmaster about postal regulations before planning a mail box post.

Clothesline posts of concrete are permanent and clean, and will not sag if they are properly placed. These posts are made and reinforced like long fence posts. Place an eyebolt in the concrete while it is still soft, to provide for attaching the clothesline.

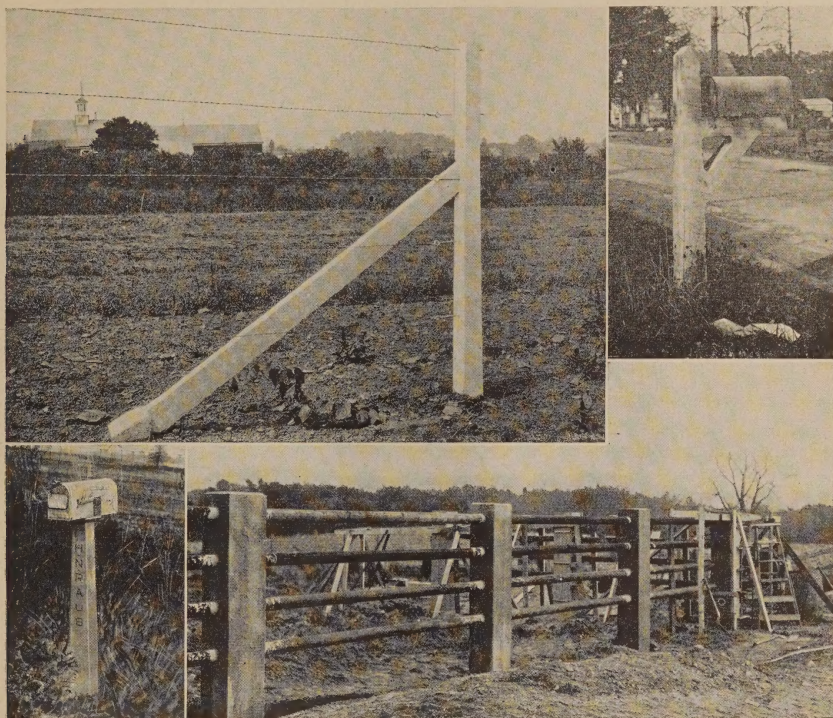
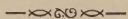
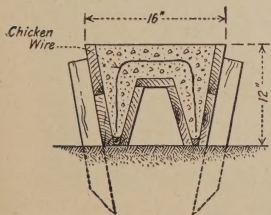


Figure 130—Concrete posts used for miscellaneous uses. Upper left shows grape-vine post with brace. Lower right shows posts for bull pen. The two other photographs are of mail box posts.



Hog Troughs and Feeding Troughs

Forms—Build a bottomless box on the ground, 6 feet long, 16 inches wide and 12 inches deep. Take three boards each 5-feet-6-inches long, and nail them together as shown at the left to form the inside of the trough. Place this inside the form with bottom up.



Place the concrete mixed in the proportion of 1 part Atlas, 2 parts sand, and 4 parts stone or gravel.

Reinforce the concrete with chicken wire, as shown by the curved lines in the drawing. After the concrete has hardened, remove the outside form, turn right side up, and remove the inside form.

These troughs require approximately 1 bag Atlas Cement, 2 cubic feet of sand, and 4 cubic feet of stone or gravel each.



Concrete Retaining Walls

Retaining walls are best built of concrete, because this form of construction is so simple and permanent, and the materials are more readily procurable everywhere than anything else that is suitable for heavy masonry construction.

There are various kinds of retaining walls, but we will deal here only with the simplest type, which is known as the gravity retaining wall and does not require reinforcement. It is the most economical, especially for walls less than 10 feet high.

How to Build Retaining Walls

The foundation is of prime importance. A good footing must be obtained, as a settlement of only a few inches might cause failure. Excavation should be carried below the frost line, which means 3 or 4 feet. Sand and gravel make good foundations when they are dry and well packed. If the soil is soft, you will have to dig deeper and fill in with gravel or cinders thoroughly packed in place.

Sizes—The wall is made widest at the bottom to give stability, and slopes gradually to the top. The slope is usually on the side against the earth. The front of the wall, however, is also sloped slightly so that the top will not seem to be tipping out. In Figure 132 is shown a cross section of a retaining wall and dimensions for various parts, all in terms of the height of the wall.

The thickness of the base of the wall should be as shown in Figure 132. The top should be 18 inches thick for walls between 5 feet and 10 feet high. Walls less than 5 feet may be made 12 inches thick at top.

Forms are constructed of 1½-inch or 2-inch lumber in accordance with Figure 133, which shows how the struts and bracing are nailed to stakes driven in the ground. As you should avoid horizontal joints in retaining walls, you had better pour the concrete in 12-foot sections. This allows you to use the same form repeatedly.

The mixture should be 1 part Atlas Cement, 2½ parts sand and 5 parts crushed stone. It is possible to save largely on materials by using field stones in the concrete. These may be of any size up to one-half the thickness of the wall and should be placed so that they will be at least 6 inches from the face of the wall, and completely surrounded by concrete. The stones are not mixed with the cement, but placed in it as it is deposited. The stones must be sound, strong and clean; wet them thoroughly before you place them. Use a medium wet mix, and fill the forms to a depth of a couple of feet dropping in the field stones as the concrete is placed in the form. Spade the concrete well next to the forms, so as to secure a satisfactory surface.

Joints—A long retaining wall expands and contracts with the heat, so it must have expansion joints to pre-

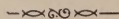
vent cracking. These joints should be placed not more than 30 feet apart; they can be placed even closer without weakening the wall. It is best, however, to key these joints together by placing a triangular shaped timber on the face of the end form; see Figure 9, page 14. This leaves a vertical notch in the concrete. The expansion joints should be about ¾ of an inch thick, and it is best to put tar paper in the joints before you pour the next section, as this prevents adhesion of the concrete.

Drainage of water from the earth held by the wall is important. If wet soil is allowed to accumulate water, it soon causes a pressure in excess of what the wall was built to stand. So be particularly careful about drainage. For larger walls, pile stone along the back and bottom of the wall (see Figure 132) to carry away the water.

For a long wall, provide weep-holes 6 to 10 feet apart, by inserting during construction 3- or 4-inch pipe near the bottom of the wall, as shown in Figure 132. The back of the wall is then first filled in with stone—a few cubic feet being placed at each weep-hole. For very wet soil, more stone must be used to secure good drainage for back filling the earth. See that the back filling is secure with the soil thoroughly compacted. Deposit it in layers about 8 inches thick, and tamp each layer of earth before the next layer is placed.

Finish—As retaining walls do not have to withstand any pressure during construction, the forms can be stripped as soon as the concrete has set enough to sustain its own weight—in about 3 days. This allows the cheapest and most permanent finishing, that is rubbing with a wood float dipped in water and sand.

A coping is sometimes placed on top of the wall, so as to provide a better appearance than a plain wall (see Figure 133). It projects 2 or 3 inches beyond the face, and is 12 to 18 inches high, depending upon the top of the wall. The top of the coping should slope slightly backward in order to prevent water from draining over and discoloring the face of the wall. To bevel or round the cornice of the coping, use a triangular strip or a cove molding in the form as shown in small detail of Figure 133.



Barn Approaches of Concrete

A solid, substantial and permanent approach to the doorway of a basement barn may be best built of concrete. Such a construction is shown in Figure 135. It consists of two side walls, which should be built accord-

ing to the instructions given on this page for small retaining walls. The slab which bridges a passageway directly in front of the basement may be built of wood. If this slab is constructed of concrete, it must be 6 inches thick and should be well reinforced.

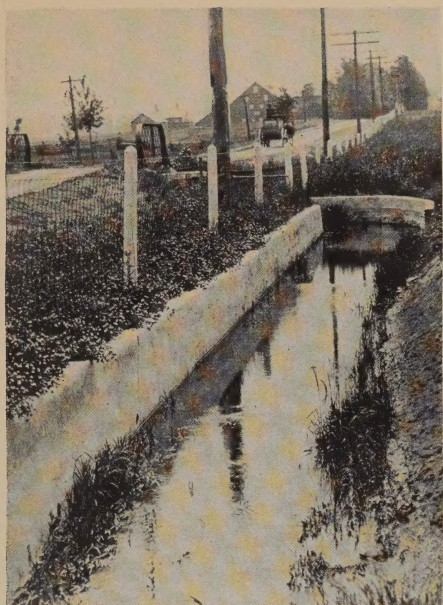


Figure 131—Small concrete retaining wall along ditch at roadside.

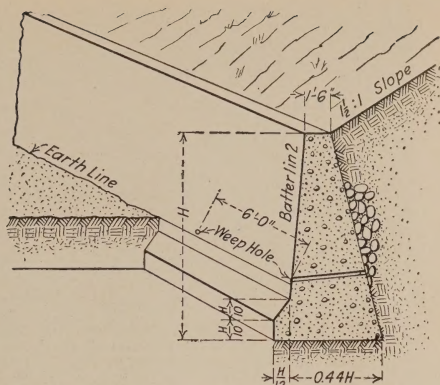


Figure 132—Cross section of retaining wall 10 feet or less in height. Letter "H" means height of wall; other dimensions are given in terms of height.

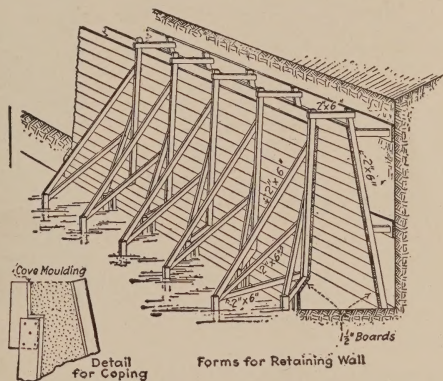


Figure 133—Forms for retaining wall. At left, form for a top coping.

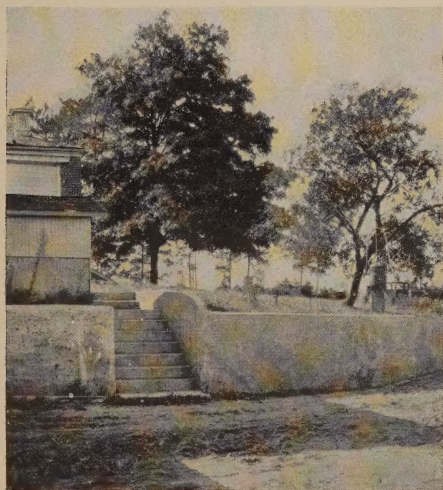


Figure 134—Small retaining wall with concrete steps.

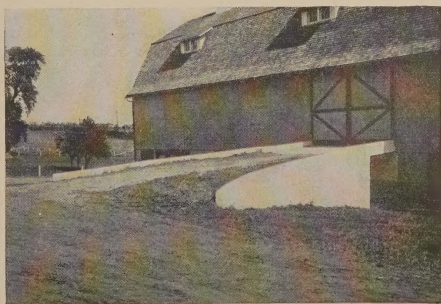


Figure 135—Concrete barn approach with self-supporting slab at doorway.

Farm Ditch of Concrete

The economy of farm drainage is well known. Wet lands are not only unsightly but unprofitable, and are breeding places for mosquitoes and other insects that spread malaria and cause discomfort. The simplest remedy is a drainage ditch. The best possible material for the drainage ditch is concrete—and it has the additional advantage of ease in construction.

Two methods of building ditches are in use—one to make the concrete ditch like a long trough with vertical sides and flat bottom. The other method is to provide sloping sides and merely cover these sloping sides with a concrete pavement laid in a manner similar to concrete sidewalks. The bottom is flat or dished. The slope of the sides should not be steeper than 1 foot rise to each horizontal foot (45 degrees).

Mixture—Use 1 part Atlas



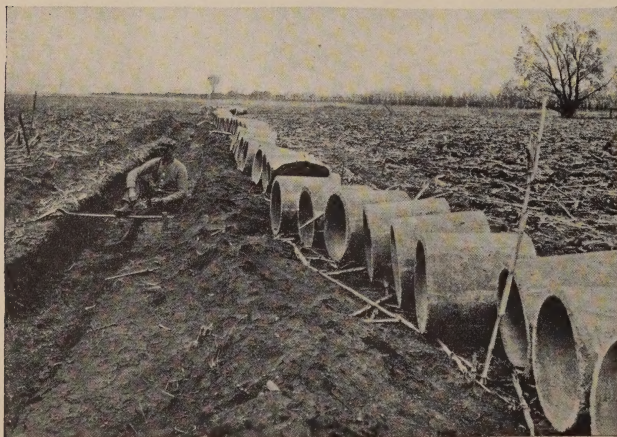
Figure 136—Part of a two-mile long flume of concrete.

Cement, 2 parts sand, and 4 parts gravel or crushed stone.

Construction—See that the aggregates are carefully selected (see page 6), and in placing employ all the possible precautions for getting a watertight concrete (see page 19). Follow the general directions in this book for foundations (page 21) and walls. With careful construction the ditch will need no finish other than rubbing with a wooden float. If you build a long flume, joints must be provided.

Drain Tile of Concrete

There are few farms on which there are not spots that are either too wet for any kind of cultivation or which are usually soggy and make plowing difficult. It is rare that such places cannot be made available for use by proper draining.



To do this by ditches is a nuisance for they interfere with cultivation and have to be continually cleaned out. The concrete drain tile is the logical method. Such tile are permanent and in most localities are cheaper than other types of drain tile.

While they are simply made it is best to buy them from reputable manufacturers of such tile, for to make them economically a large plant and expensive apparatus is required.

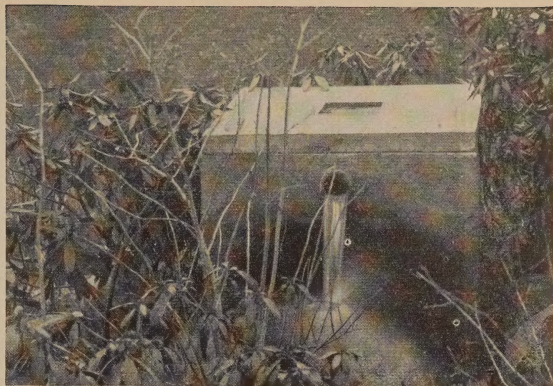
Tile must be laid carefully to the proper grade and the outlets should be properly protected to prevent clogging.

Figure 137—At left: A line of concrete drain tile ready for laying in ditch.

Spring Boxes

The spring as the source of drinking water supply is so easily contaminated by animals that it should be enclosed. Wood, used for this purpose, lasts only a short time. Concrete lasts forever and is sanitary. It is so substantial that even the larger animals cannot harm or disturb it.

Temporary divert the outflow of the spring if possible, and excavate a ditch about 12 inches deep, enclosing the entire spring. Build the walls 6 inches thick, making them of a mixture of 1 part Atlas



cement, 2 parts sand, and 4 parts stone or gravel. (See page 15 for wall forms.) Bring the top of the wall about 12 inches above the water.

Build a cover 5 inches thick for the spring box, following instructions for cistern covers on page 59. Make this at one side, on a temporary platform and slide it into place afterward. Then you won't have to place any forms in the spring.

Quantities required—For a box 3 feet square, with foundations 12 inches below ground, walls 6 inches thick and 18 inches above ground, and a cover 5 inches thick, you will need 3 bags Atlas Cement, 6 cubic feet sand, and 12 cubic feet gravel.

Concrete Blocks for Building

Concrete block buildings have the great advantage of being nearly free of upkeep cost. This is particularly true of structures that are exposed to excessive dampness, such as ice houses, milk rooms, tank rooms, etc. Concrete block are also an ideal material for all types of farm structures, such as the house itself, the barns, corn cribs or any of the many buildings that the farmer needs.

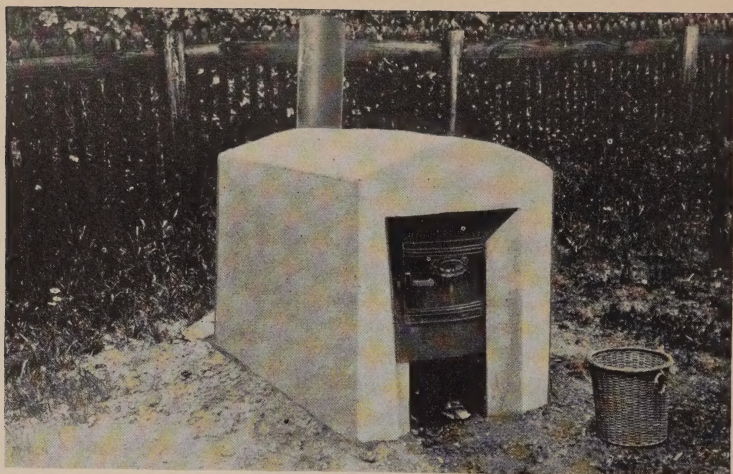
Concrete blocks and concrete bricks are best secured through the local manufacturer and can be secured in practically any locality. While they can be made at home, the number that are to be used may not make it feasible for the user to buy the necessary equipment or install the apparatus that is needed to cure the blocks properly.

The blocks are laid up in the same way as any other masonry. For small structures, they can be plastered

directly on the inside with a Portland cement mortar. This is a great convenience when the building—such as a milk house—must be constantly washed inside. In houses the interior plastering should be applied on lath.

Concrete blocks are permanent and fire resistant. The upkeep cost is very low and cost of construction in concrete block is but very little over that of a frame construction.

If you are planning to build with concrete blocks, write for our free book giving directions for using blocks.



Concrete Garbage and Trash Burners

Garbage or trash burners of concrete are safe, inexpensive and easy to build. They afford a safe means for disposing of all the papers, boxes and trash which accumulate around the house.

Foundation—To construct a simple structure like the one shown in Figure 138, make an excavation 4 feet long, 3 feet wide and deep enough to reach firm subsoil (usually about 2 feet) and construct the foundation of field stones, graded from large at the bottom to smaller sizes at the top.

Floor—Place concrete for the floor or bottom of the burner 6 inches from the surface. This should be mixed in the proportions of 1 part Atlas Cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel or crushed stone.

The walls should be 6 inches thick and 4 feet high. For wall forms see page 15. Use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel.

Provide the openings for doors and for removing ashes, which are shown in Figure 138.

The grate and hinges for the doors are fastened to the side walls by means of eyebolts placed in the walls when they are being poured. This is done by

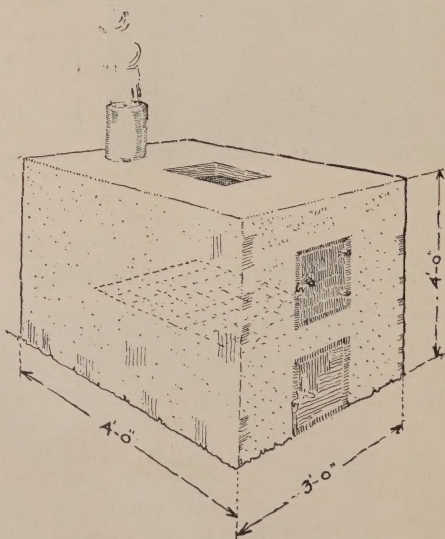


Figure 138—Drawing of trash burner showing dimensions. Opening in roof is in case the burner is to be used as a feed cooker. A cover should be provided for this opening to insure good draft when the burner is not used as a feed cooker.

boring a hole in the forms when erected, and slipping the straight end of the eyebolt through the form where it will become imbedded in the concrete. The eye furnishes a rest for the grate. The grate should be placed before the cover is constructed. The eye of the eyebolt also provides a hinge in which and upon which the door-hinge insert swings.

The roof or cover should be of the same mixture as the walls and 6 inches in thickness, and reinforced with two $\frac{1}{2}$ -inch rods, 2 feet 10 inches long and two $\frac{3}{4}$ -inch rods 3 feet 10 inches long, placed within one inch of the bottom of the 6-inch roof-slab; one rod at each end and one rod on each side of the opening 1 inch from it.

Leave a round opening in the roof and insert a piece of stove pipe as a chimney.

If you leave a larger hole in the roof, the burner can be used for a feed cooker.

When the burner is roofed over, the forms must be burned out.

Septic Tanks

There is nothing that is such a nuisance or so positively dangerous to health as the ordinary outside privy on the farm or in the small town. It is not only unpleasant, due to its odor and the flies it breeds, but it spreads diseases such as typhoid, dysentery and hookworm. A cesspool is little better, as it must be cleaned out often and it is difficult to dispose of the contents satisfactorily.

The concrete septic tank provides a sanitary and practical method of disposing of house sewage. It allows the use of bath-tubs and water-closets in the house. The kitchen sink also can be drained into it.

A septic tank is a covered concrete tank divided into two compartments, one larger than the other. The sewage first enters the large compartment. The tank,

being dark and warm, is an ideal breeding place for bacteria or germs that liquefy the solid matter. This action takes place in the first chamber. The liquid then passes through an opening in the partition into the smaller compartment, from which, when it gets to a certain level, it is automatically discharged by means of a syphon into drain tile, laid with open joints, from which it seeps into the ground.

How a Concrete Septic Tank is Built

Figure 139 shows the layout of a septic tank. A 4-inch sewer line runs from the house to the tank. This inlet line is laid with tight joints and enters the tank with an elbow so that the waste enters below the water surface of the larger chamber. This is to prevent the rush of water from disturbing the scum which forms on the surface and which must not be broken up or disturbed if the bacterial action in this chamber is to be complete. Two baffle boards, placed across the tank (see the diagrams) help prevent the scum being disturbed. As the water rises in the large compartment, it flows through an inlet pipe into the small compartment from which at certain intervals, about 4 to 6 hours, it is automatically siphoned off into the disposal drain. (Siphons can be procured from local hardware dealers or names of manufacturers may be secured from the Atlas Portland Cement Co.) The disposal drain is made of 4 inch pipe laid with tight joints up to the ends of the four branches. The branches are laid with open joints (see details on page opposite) about 18 inches below the surface of the ground. The length of these disposal lines depends upon soil conditions and the number of persons in the house. For sandy soil allow about 35 feet for each person served and in loamy soil 60 feet. The tank described in this article is for eight per-

sons, so that it will require a total length of unjointed drain of 280 feet for sandy soil, or 480 feet for loamy soil. This length can be divided between four or six lines as desired. The layout is shown in Figure 140.

If the soil is gumbo or clay, a rock filled ditch (see detail) will have to be used as shown in Figure 144. Allow 60 feet of this drain for each person served. Figure 143 shows the tank complete with the exception of the roof. The reinforcing bars projecting from the walls are bent over into the cover.

The construction of the forms for the tank is the same as for the tank shown on page 80 in Figure 145. The concrete is mixed in the proportions of 1 part of Atlas Cement, 2 parts of sand, and 3 parts of stone. This size tank will require 44 bags of Atlas Cement, 88 cubic feet of sand and 132 cubic feet of stone or gravel. The roof is reinforced with $\frac{1}{4}$ -inch round rods, spaced 6 inches apart each way, 1 inch from the bottom. The covers are reinforced with chicken wire and an eyebolt is cast in the cover so that it can be easily removed.

Note—The tank must be constructed with the greatest care, or it will require frequent cleaning and will be otherwise unsatisfactory.

(See drawings on page 80)

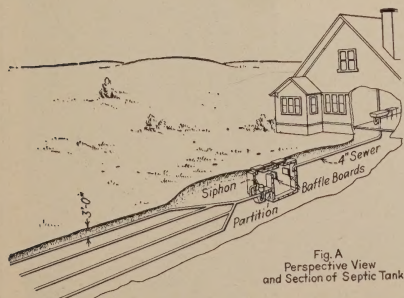


Fig. A
Perspective View
and Section of Septic Tank

Figure 139—Perspective view of septic tank showing its relation to house, and the location of drain tile lines.

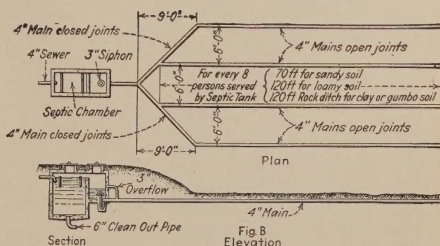


Figure 140—Plan giving dimensions for drain tile discharge line.

(For directions, see page 79)

Figure 142—At right: Sectional view of septic tank. Exact placing of siphon should be in accordance with the manufacturer's directions.

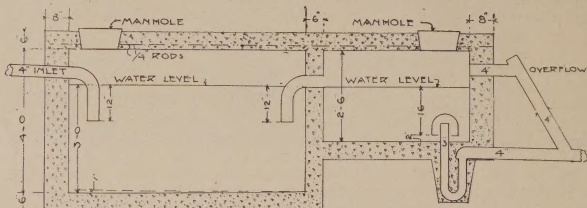


Figure 143—Below: Drawing showing view of tank from above. The reinforcing bars projecting from the walls will be bent over to serve as anchors for the roof.

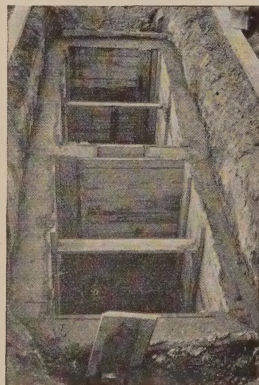
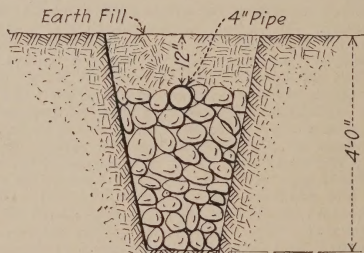
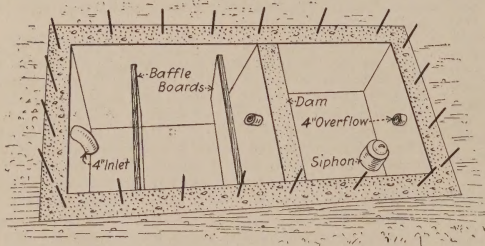
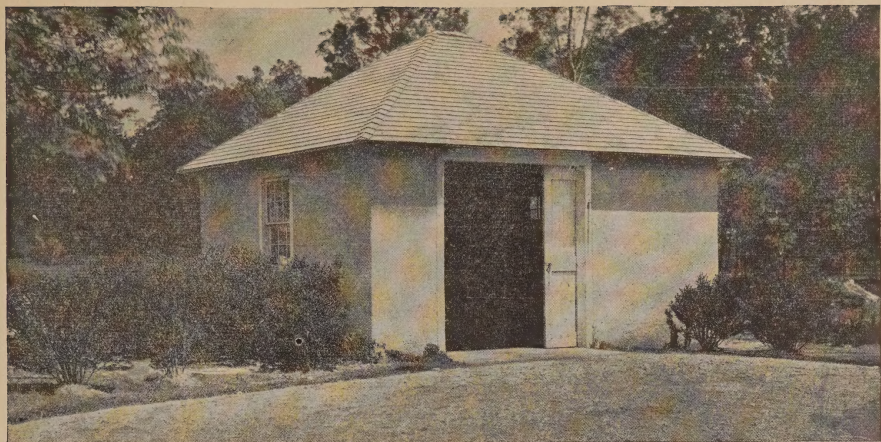


Figure 144—Above and at right: Cross section of drain tile discharge ditch in clay or dense earth.



Figure 145—At left: Construction of septic tank showing inside forms in place. Earth was sufficiently hard in this case to serve as outside forms.

Figure 146—Septic tank after forms are removed. Notice automatic siphon in place. Reinforced concrete roof will be placed after baffle-boards are inserted in vertical notches in the walls.



Automobile and Tractor Garages

It is hardly necessary to argue the advantages of a fire-resistant, economical concrete garage for your motor car. The advantages of proper housing of tractors, however, are not as well understood. Proper care of tractors is important, for a tractor, kept free from weathering, rust, and dust, will last longer than one left out in the open and will have a greater second-hand value. Also a tractor, kept in perfect adjustment, with small repairs promptly made as needed, will do better and more constant work than a tractor that is allowed to work loose and get out of order.

Constant use of a tractor, its longer life, its greater second-hand value, better work done, and the freedom from large repairs—all this means money saved.

The life of other farm implements and machinery has been lengthened from five to ten years by proper care and housing. A tractor is at least as delicate a piece of machinery as any other mechanical appliance used on the farm, and its life can certainly be lengthened several years by keeping it in a weather-tight garage with a good floor and a tight roof.

For these reasons, every farmer should have a perfect shelter for his tractor in which it will be safe from weather—even over night. You should also have a work-bench handy with tools and extra parts, so that you can make proper adjustments and keep your tractor always working at top efficiency, and, by making small repairs from time to time, you thereby make it unnecessary to send the tractor to a distant machine shop, which would cause

excessive expense, and annoying, costly delay.

An excellent idea, for economy and convenience, is to build a garage large enough to house both motor car and tractor.

Location—The tractor and motor car garage should be near the barn and other farm buildings, so that without moving the tractor from the garage (or at least with as little shifting as possible) it may be used for cutting ensilage and feed, shelling corn, sawing wood, baling hay, pumping and the other belt work to be done throughout the fall, winter and spring.

The garage should therefore be either fire-resisting or completely fireproof; and this means that it should be concrete or stucco.

A garage of this kind is moderate in first cost, of good appearance, is easily kept clean, and is permanent. It requires little or no upkeep or repairs, and protects the contents against fire.

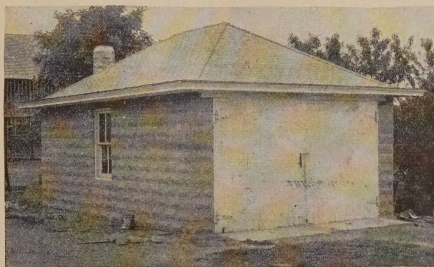


Figure 147—Concrete block garage with wood roof. Plain concrete blocks covered with stucco shown at top of page are now more popular than the rock-faced blocks used in this garage.

(Continued on page 84)

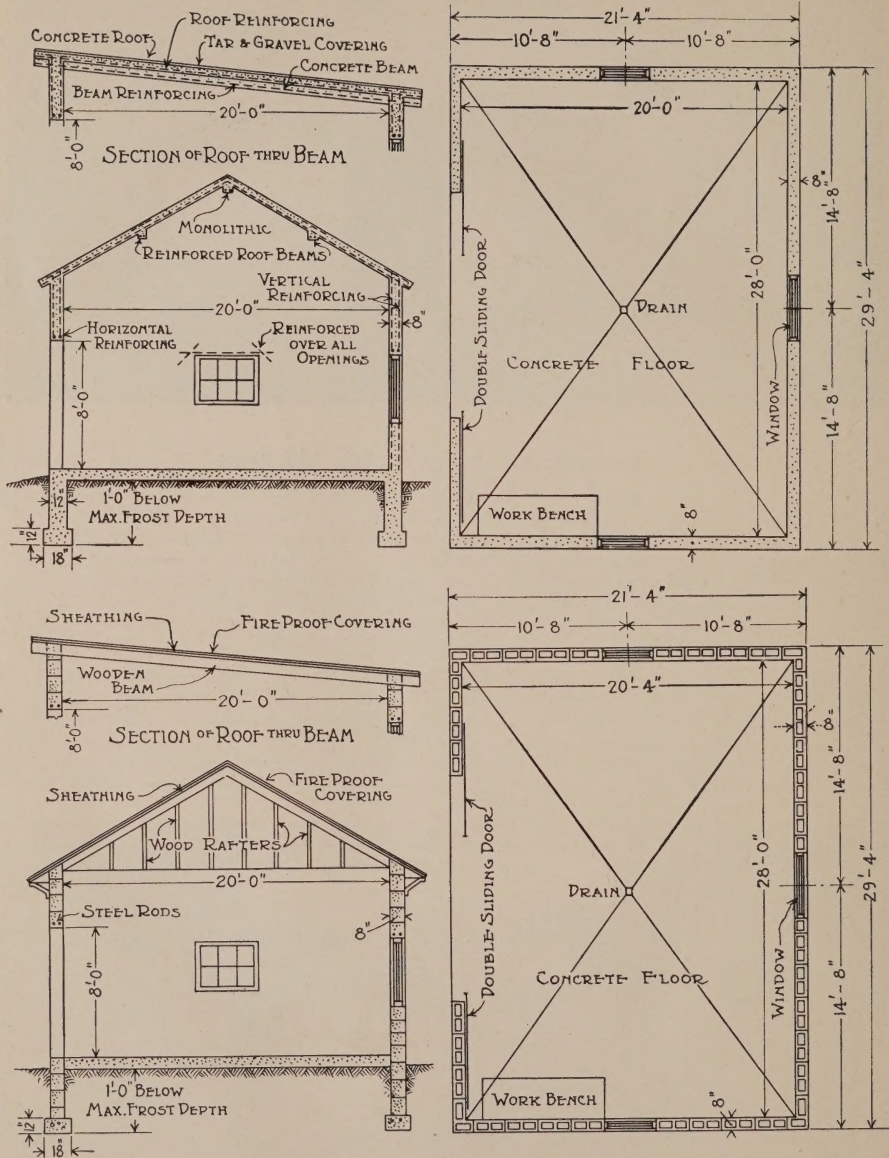
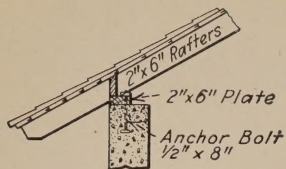
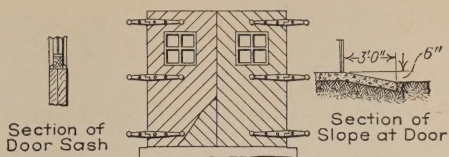


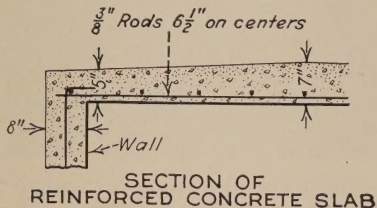
Figure 148—Two types of concrete garage construction. At top of page reinforced concrete, and below concrete block with wood roof. In both plans the alternate types of roof are shown—peaked and flat. The flat roof is easier to construct but does not have as good an appearance as a peaked roof.



SECTION OF WOOD
ROOF AT EAVES

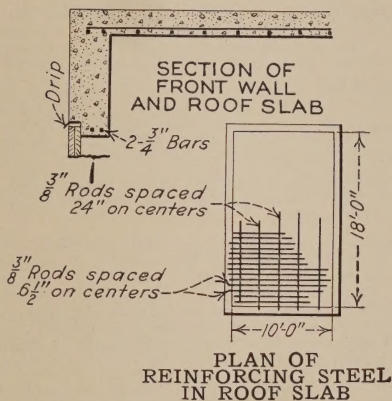


DETAILS OF DOORWAY

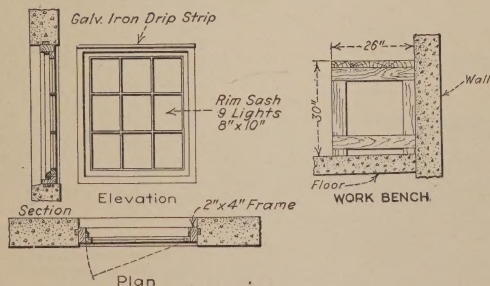


SECTION OF
REINFORCED CONCRETE SLAB

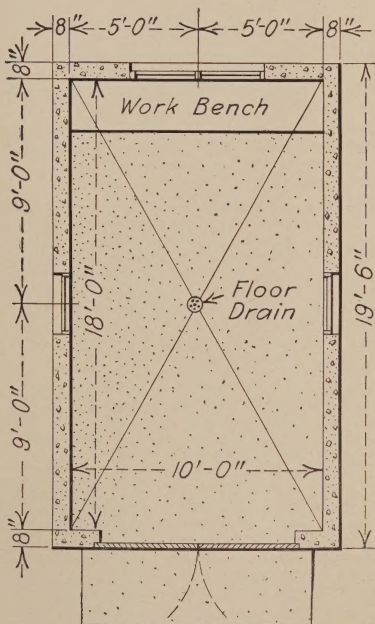
Figure 149—Details for small single-car garage which is also suitable for a tractor. Notice that details are given for two types of roof—a flat slab of reinforced concrete and a peaked roof of wood. While a reinforced concrete roof combined with concrete walls gives the last word in fireproofness, it is not always considered necessary to go to such extremes in a small garage unless it is very close to an inflammable building such as a wood barn. Under ordinary conditions a wood roof will generally prove acceptable.



PLAN OF
REINFORCING STEEL
IN ROOF SLAB



WINDOW DETAIL



PLAN OF GARAGE

(Continued from page 81)

Such a tractor garage can be built, at very little extra cost, sufficiently large to house both tractor and motor-car or motor-truck, or another tractor, or some other piece of farm machinery which you may want to treat with particular care.

With the help of your farm hands, by making use of your own building ingenuity, you should have no trouble in constructing a garage of this kind when the other farm work is slack. The sand and pebbles you probably have on your own place. The cement and other materials can be obtained from your local dealer.

If you find that your regular farm work is requiring all your time, then the best policy would be to have your local contractor build you a garage.

Figure 149 shows plans for small single-car garages. Figure 148 are for garages 20 x 28 feet, which is the proper size for housing two tractors of average dimensions, or one tractor and a motor-car, with ample space around both machines, also for a work-bench fitted with tool-rack, and for shelves. The average size tractor means: 130 to 150 inches long, 56 to 60 inches wide, and 60 to 70 inches high. There are tractors which are fitted with special tops of heights exceeding 70 inches. If your tractor is one of this type, this feature can be provided for by making the door higher than the 8-foot height, as shown on the sectional view. The window openings can be made of any size window-frame that you can obtain in your community.

Concrete Block Garage

This is the cheapest fire-proof construction. (See Figures 147 and 148.) It is well to bear in mind, that for completely fire-proof construction, the roof must be concrete.

Construction—Concrete footings, concrete block foundation, concrete floor, block walls, and either a fire-proof concrete roof or wooden roof covered with fire-resisting material.

Footings and Foundation—The concrete footings are carried to a depth of 1 foot below maximum frost depth in order to prevent settlement-cracks in the building, and are 12 inches thick, 18 inches wide, and made of 1 part of Atlas Cement, 2 parts of clean well-graded sand and 4 parts of clean well-graded crushed stone or pebbles. The concrete block foundation, which rests on the concrete footing, is 8 inches thick made of cement blocks which are laid in cement mortar made of 1 part cement and 3 parts of sand.

Floor—This should be made 8 inches thick of concrete mixed in the proportion of 1 part Atlas Cement, 2 parts of sand and 4 parts of stone or pebbles. Tamp the ground thoroughly and wet it before laying the concrete. Slope the floor slightly toward the drain in the center. Finish with a wooden float to give a surface which will not be slippery when wet.

Roof—Can be any of the styles shown in Figures 148 and 149. The covering for wooden roof should be fire-resisting, for example, asbestos shingles.

Stucco Garage

Walls—2 x 4 inch studs nailed to the wooden sill which rests on the concrete block foundation; 1½ x 2 inch furring strips nailed to the 2 x 4 studs; metal lath fastened to the 1½ x 2 inch furring strips; three coats of stucco placed on the metal lath makes a cheap and excellent construction. The three coats of stucco, each ⅜-inches thick, should be made of 1 part of Atlas Cement and 3 parts of sand. In order to have a mortar which works better under the trowel, it is recommended to add 1/10 part of hydrated lime by volume to the amount of cement used.

Finish—For the finish coat either a white or gray color can be obtained. If the former is desired, use Atlas White Cement. The ordinary Atlas Cement will give a finish color of gray.

Roof—Either a peaked or flat roof can be used as shown on the plan for a concrete block Tractor Garage. Whichever type of roof is chosen, it should be covered with a fire-resisting material, such as asbestos shingles as before mentioned.

Reinforced Concrete Garage

Construction—Concrete footings, foundation, floor, walls, and roof. If it is desired to construct a wooden roof, a roof such as shown on page 82 for concrete block garage can be used. (See Figures 148 and 149.)

Foundation—The 12-inch concrete foundation is carried to top of concrete floor and made of 1 part of Atlas Cement, 2 parts sand and 4 parts of crushed stone or pebbles. The reinforcing rods for the walls are tied into the top of the foundation.

Floor—The floor is laid in a similar way as noted in the description for the floor in connection with the concrete block garage.

Walls—The 8-inch reinforced walls should be monolithic construction, that is, the concrete placed continuously in order to secure a smooth and pleasing finish. All door and window openings should be blocked out in the wall forms. Steel rods should be placed over each window and door as shown. The mixture used should be 1 part Atlas Cement, 2 parts sand and 4 parts of crushed stone or pebbles.

Roof—The concrete roof can be made either of the two styles shown in section. The wall reinforcing rods should be tied into the roof as shown, and the roof beams and roof should all be poured at the same time. The mixture used should be 1 part of Atlas Cement, 2 parts of sand and 4 parts of crushed stone or pebbles, no size of which shall be larger than ¾-inch in diameter. After the concrete has hardened it should be protected from rapid drying out, by wetting the surface with a hose several times a day for about 7 days. If a flat concrete roof is chosen, it should be covered with tar and gravel. A wood roof, covered with fire-resisting material, can be used as shown on sectional view of Concrete Block Garage.

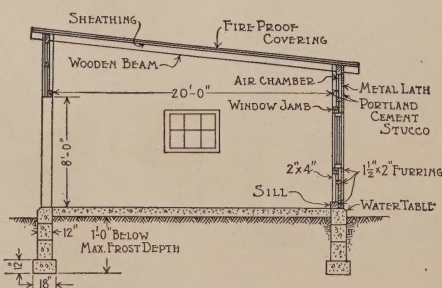


Figure 150—Cross section of stucco garage with concrete floor and foundation. Framework is of 2-by-4 wood studs covered with metal lath.



Figure 151—Concrete culvert having concrete end walls with circular pipe opening for water. With this type it is necessary to have an adequate fill of earth over the top of the pipe to cushion and distribute the load, otherwise there might be danger of cracking or collapsing the pipe.

Concrete Culverts

Good drainage is the fundamental principle of good roads. Drainage culverts constructed of concrete are strong, permanent and do not rot or rust. Concrete culverts are strong enough to withstand any load that will come on the road such as a threshing machine or road roller. Properly constructed, they last forever.

They Are Easy to Build

Construction—Concrete culverts are easily constructed. The ordinary type is shown in Figures 154 and 155, and is called the square or box type. It consists of a long, square concrete box under the road with a wall at each end to keep the earth in place.

Start the construction when there is very little water in the stream. As concrete cannot be placed in moving water, it will often be necessary to divert the water while the culvert is being built. This can be done in several different ways. If the amount of water is very small the stream can be temporarily dammed. If the culvert is large enough, a flume or box of wood lined with tar paper can be used to carry the water, or a temporary channel can be built through some other section of the road, but in no case should the water be allowed to flow over newly placed concrete.

Size—It is first necessary to determine the size of the opening for the culvert. This can usually be determined from the existing culvert or some other culvert through which the stream flows. It is better

to have the culvert a little too large than not large enough in case of heavy rains.

Foundations and forms—To build a culvert first excavate at least 6 inches below the existing bed of the stream for a width a little more than that of the culvert. Build the side forms for the culvert as shown in Figure 155. This form consists of 2-by-4 stakes driven into the ground and held together at the top by cross pieces. To these 2-by-4's are nailed inch boards to the height of the culvert. Build the inside form ready to place in position. Plan all the pieces so that they can be knocked-down easily for removal after concrete has hardened.

Then place 6 inches of concrete in the bottom of the forms.

Now place the inner form in position on the partly hardened concrete of the floor and continue the pouring of walls and top of culvert.

Mixture—Use throughout a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. The outside forms can be removed in a few days, but the inside



Figure 152—Combined steps, retaining wall and culvert to entrance sidewalk over road ditch.

forms should be left in place for several weeks. They can be removed by knocking out the inside bracing and pulling out the boards forming the top and sides.

Concrete head walls are often built for pipe culverts and the construction of head walls is the same as for the culvert shown in Figure 151. The space in front of the outlet end of all culverts should be faced with concrete to prevent erosion of the soil and consequent undermining of the end of the culvert.

Reinforcement—When the span is more than 2 feet the top slab of the culvert should be reinforced. This can be done by using expanded metal lath or steel rods. The table below gives the amount of reinforcement for different lengths of span and size of top slab and walls.

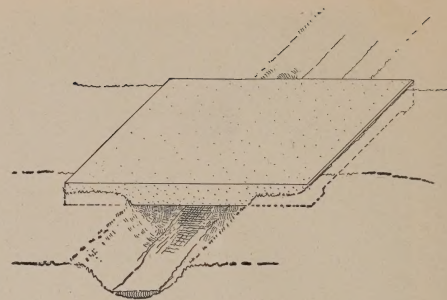


Figure 153—A simple reinforced concrete slab for bridging over a ditch at the side of the road. The sizes given in the table at the left may be used for this slab by omitting the sidewalls.

Span	Thickness of top slab	Thickness of side walls	Size and spacing of round rods
2 feet	6 inches	12 inches	$\frac{3}{8}$ -inch; 6 inches apart
3 "	6 "	12 "	$\frac{1}{2}$ " 8 " "
4 "	6 "	12 "	$\frac{1}{2}$ " 6 " "
5 "	7 "	12 "	$\frac{5}{8}$ " 6 " "

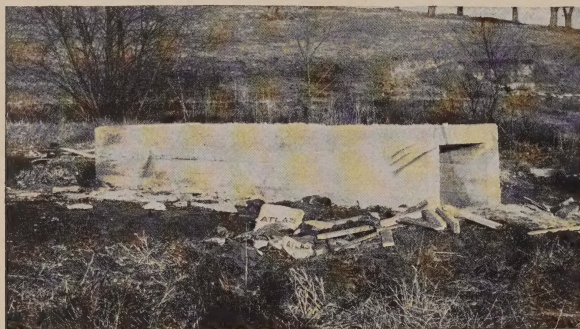


Figure 154—At left: Concrete box culvert under construction before road fill is made. Roadway will afterwards be filled over the top of this culvert. It is always best to provide end walls as shown in the drawing, Figure 155.

Figure 155—Below: Drawing showing construction of forms for concrete culvert with end walls. See directions on page 85 for construction of this type of culvert.

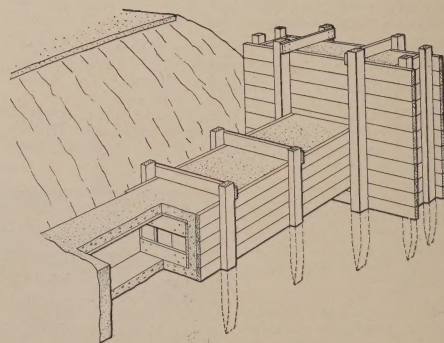


Figure 156—At left: Concrete culvert end walls at intersection of road.



Chapter 4—Concreting in Cold Weather

You can do some of your concrete work during cold weather—late fall and winter—when you have more time than in the summer. This will mean a little more time and care, but as there are not so many demands on your time at this period of the year we are sure you are justified in spending more of it on your concrete work. You can keep your help busy, too, making a lot of things which you really need and which you might not have the opportunity to make during the summer months. Farmers, contractors and cement products manufacturers are now carrying on their concrete work during the entire year, handling it as successfully in winter as in summer.

What Can Be Done

The things that can be made during the fall and winter months, generally indoors, are fence posts, blocks, drain tile, interior floors, small feeding troughs, water tanks, and vats; also some outside work such as foundations and floors where a thorough protection during early hardening of the concrete can be provided.

For example, one of the things you can do in the winter is to put a concrete floor in that

machinery shed. Just level up the earth, filling in the ruts and holes. Put on a four-inch concrete floor which can be easily protected from the wind and coldest weather; and you'll have an improvement that you will enjoy every day of your life on the farm (see page 33 on "floor construction"). You will remember the winter you laid that machinery shed floor as one that was well spent.

Effect of Cold Weather on Concrete

Experience has shown that the effect of heat on concrete is to hasten setting, and the effect of cold is to retard setting. During cold weather concrete sets and gains strength very slowly. If subjected to freezing temperature, it will freeze. It has been found that concrete which is frozen only once and then allowed to thaw out and properly harden is not injured, but concrete which has alternately frozen and thawed loses its strength and is unsatisfactory. It should be carefully protected and not allowed to freeze at all.

Frozen concrete closely resembles properly hardened concrete and will give a resounding ring when hit with a hammer, the same as good concrete. The way to distinguish between the two is to place a piece in boiling water; if it is frozen it will become soft.

It has been generally proven that concrete which has been protected from freezing for forty-eight hours to four or five days, depending upon the degree of cold, can then be subjected to freezing weather without danger of having bad results. *The thing to do when handling concrete work in cold weather is to have conditions as near like those of summer as are possible to secure*; that is, do the work inside a room heated to at least fifty degrees Fahrenheit, and allow the concrete to harden in this temperature; or, to do the work outside, heat the materials, place the concrete quickly and protect it by covering, so as to retain its heat as long as possible. When weather conditions require it, provide artificial heat during early hardening. Concrete itself develops some heat during the hardening process.

Indoor Work

Where possible, it is best to have work done in a room or shed which has been heated to a temperature of fifty degrees or higher. Such work includes fence posts (page 68) and pre-cast work for use about the house and barn, such as blocks (page 77), and drain tile (page 76), some interior floors, such as barn (page 32),

cellar (pages 33), stable (page 32), garage (page 81), feeding troughs (pages 73), and small tanks (pages 58). Complete directions for doing such work are given in this book on pages above mentioned.

You may be able to use the cellar or basement or some shed or outbuilding which you can heat

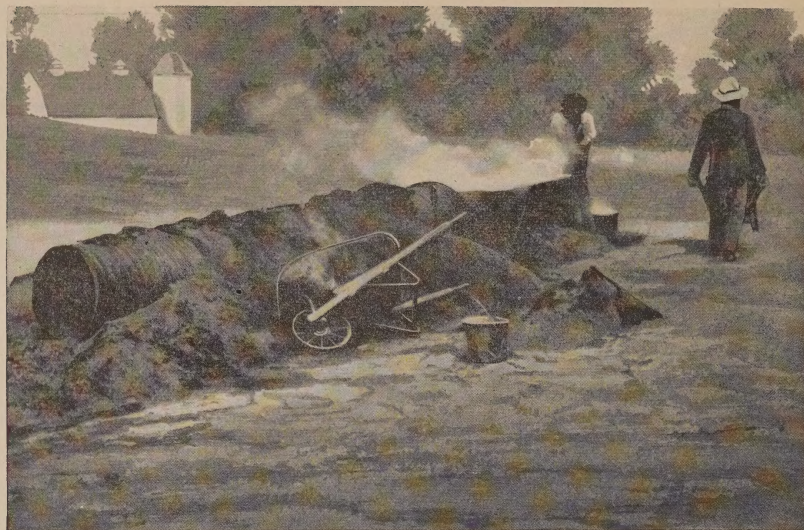


Figure 157—Method of heating sand, gravel and water for mixing concrete. Notice section of old sheet iron culvert pipe covered with sand and gravel; fire is built inside of the pipe. At rear is old cauldron for heating the mixing water with fire built underneath.

with an old stove. Possibly you can use a room where feed for stock is cooked. It should be large enough to hold a two or three days' supply of sand and pebbles warmed sufficiently to remove frost or frozen lumps before using. Keep the room day and night at about fifty degrees if possible—at least above freezing; the temperature may drop some at night. Then allow the work to remain in this temperature for a few days until hardened properly. Pans of water should be placed in the room so as to

provide the right amount of moisture and not allow the concrete to dry out too rapidly; also sprinkle the fresh concrete with water two or three times a day for the first few days, starting this after the concrete has become hard.

If you have some inside work to do, such as barn floors, and the space is so large that it cannot be properly heated, you should follow the same practice as for outside work; that is heat the materials and protect the concrete as described later on.

Outdoor Work

For outside work, when the temperature is fifty degrees or less, the materials should be heated and the concrete mixed and placed in the forms as quickly as possible and then covered with canvas or boards, which in turn are covered with straw or manure (manure has considerable heating value), so as to retain the heat. When using manure, first cover the concrete with building paper or other material, so as to protect it. (Liquids from manure are liable to injure fresh concrete but will not harm properly hardened concrete). When the temperature is around freezing it is advisable, in addition to heating the materials, to use artificial heat, which can be provided by oil burners

or wood burning sheet-iron stoves, so as to allow the concrete to harden properly.

The class of work you can do, according to this plan, includes some piers and foundations (pages 21) and some outside floors, such as barn entrance (page 32) and feeding floors (page 38), where the work can be properly covered and protected during the early hardening of the concrete. Be sure that if your excavation does not go below frost level, as in the case of floors, you remove the frost from the foundation or use reinforcement to span any uneven settlement of the foundation which is sure to follow in the spring of the year when the frost comes out of the ground.

Whatever you do, be sure to heat the water, sand and pebbles and protect the concrete so that it will not freeze. Keep the concrete as

warm as possible for the first few days and leave the protection on for a couple of weeks to insure proper hardening.

Heating the Materials

The three materials to be heated are the water, sand and pebbles. It is not necessary or advisable to heat the cement.

About the best way to heat water for doing work on the farm is to use a large kettle over an outside fire. Sometimes stoves are available and water can be heated in large cans. Sometimes it is possible to use heaters which you may have for heating hog feed and the same kettles or cans for water. Any method of this kind which will furnish an ample supply of hot water is satisfactory. The water should be really *hot* (about 150 degrees), not lukewarm. Bear in mind that the water must be thoroughly clean and free from dirt or grease. If you use kettles or cans which have been used for heating hog feed or other materials, be sure that any dirt or grease is removed, so that the water will be thoroughly clean.

There are different ways of heating the sand. The simplest plan and the one generally followed is to use a curved piece of sheet iron or large iron culvert pipe or part of an old boiler. Have a fire inside with the sand and pebbles piled above. Keep a good hot fire going and use a rake, hoe or shovel to keep the sand and pebbles thoroughly stirred so that they will be uniformly heated. Be sure to keep the sand and pebbles separate. As a general rule, the sand and pebbles are not overheated, but it is possible to get them too hot, and then they will become soft. This is something that can be easily watched during the heating. The illustration shows how this method is successfully carried on. Heating these materials will allow you to place the concrete at about seventy to eighty degrees, which is right.

Protection of the Work

When it is not too cold, the heated concrete can be covered with boards on which about twelve inches of straw or manure is piled. Instead of boards, a rack can be built over the concrete by use of timbers on which canvas or burlap bags are spread and the covering placed on top of this. Be sure to have the covering extend not only over the top but also down the sides so as to thoroughly enclose the concrete work and keep in the heat.

In the case of colder weather, when using artificial heat, it is very important that the same principle be followed, that the covering used thoroughly encloses the work. Generally in the case of employing artificial heat, a canvas or tar paper covered with straw or manure is used, which is sufficient under ordinary circumstances to retain the heat.

There are different methods that can be used to provide artificial heat. The oil stove or four-burner oil-lamp is very satisfactory and it may be necessary to use several, depending upon the size of your work.

Any stove or lamp of sufficient size to provide the right temperature under the weather conditions and which will not set fire to the covering should prove satisfactory. It is a good thing to have a thermometer in the room so that you can watch the temperature from time to time and be sure you have sufficient heat.

You will find these directions for cold weather concrete work easily followed and you will be able to make many improvements which you might not otherwise have. It is a good plan, of course, to have the sand, cement and pebbles hauled before bad weather sets in.

Briefly

Concrete hardens more slowly in cold weather than in warm temperatures. Although the temperature may not be freezing, it may be enough to delay hardening.

Alternate freezing and thawing within the first few days will render concrete valueless.

The concrete work should be handled so as to harden before being exposed to freezing temperature.

Be sure to remove all snow and ice from forms before using.

In cold temperature heat the water, sand and pebbles, so that the concrete can be placed at a temperature of from seventy to eighty degrees. Place the concrete quickly and protect it so as to retain the heat.

In freezing or colder temperature supply artificial heat to maintain a temperature of at least twenty degrees above freezing for not less than five days.

Be sure to test the concrete thoroughly so as to make sure that it has hardened before forms are removed.

Chapter 5—Concrete About the Home

Practically all of the information and directions in the preceding chapters can be applied to concrete work about the home. It is obvious that when building steps, a driveway, a foundation, etc., the construction methods are the same whether the work is done on the farm or about the home—whether the location is in the country, in the town, or in the city. Therefore, it is not necessary to repeat this information when describing the many uses of concrete around the house and the house grounds.

Every home owner takes pride in having his house and land look neat and well-kept. Much can be done with concrete whether the grounds are part of a large estate or whether only a city lot. Nor is it merely a matter of pride in appearance that prompts the careful home owner to keep his property in good condition, for he realizes that the sale value can be kept high by a few well considered improvements. A few dollars invested in a new porch floor, a driveway to the garage, or an ornamental pool may increase the value of the property many times the cost of the improvements.

Repairs and Improvements for the House

Portland cement may be used for both the exterior and interior of a house. For the exterior it may be used in making a permanent and rot-proof porch floor, concrete piers, to replace wooden supports for the porch, for steps, foundation, chimney caps, and for stuccoing the walls. In the interior of the house Atlas White Portland Cement may be employed for finishing the inside surface of the walls in one of the latest and most popular types of rough textural finish, for making a concrete floor in the bathroom or as a foundation for a tile floor, for a concrete floor in the cellar, and for many similar uses.

Porch Floor—For general directions see pages 33 and 34. If possible make the porch floor self-supporting by means of reinforcing bars, as concrete floors usually crack if laid over wooden

supports as in the case of an old wood floor. Where an ornamental effect is desired, use two-course construction (see page 30). Make the first course or base course of gray Atlas cement, and for the top course use Atlas White Portland Cement mixed with colored sands or color pigments. Write the Atlas Technical Department for information on color pigments and names of manufacturers supplying them. A pleasing effect can be secured by having a border around the porch floor about 12 inches wide, made with gray cement with the center portion of Atlas White cement, sand and red coloring pigment. Mix up enough cement, sand and various amounts of coloring pigment to make sample pats of mortar. Keep a record of the exact amounts of pigment used in proportion to the cement. Let the sample pats harden and dry out, and choose the proportion of pigment which gives a deep red color.

When the red mortar top coat is in place trowel and finish it as directed on page 30 and then while it is still soft, mark into 6-inch squares with a grooving tool, as shown in Figure 36. This will give the effect of red tile.

If the old porch floor was supported on wood posts replace these with concrete posts as mentioned on page 23.

Porch and Cellar Steps—Wooden porch steps are the first thing to rot out and it will be economical to replace them once and for all with concrete (see page 27 on steps). Steps for the front porch or front entrance may be made more ornamental by using colored mortar or concrete made with Atlas White. For especially good results the colored concrete should be rubbed down with a carborundum stone and water.

Rain Gutters—Frequently the rain water discharged from conductor pipes and down-spouts cuts an unsightly furrow through the lawn. Build a concrete gutter to receive this water and carry it to some lower spot or to a gutter where it will do no harm. Use a 1:2:4 mixture and hollow the top surface.



Figure 158—Examples of the use of ornamental concrete for ornamenting the house grounds. Even the "backyard" of a city house can be made a beauty spot by the judicious use of ornamental concrete.

Concrete Chimney Caps—Old brick chimneys with brick chimney caps sometimes become unsafe if the mortar between the bricks becomes loose. The remedy for this is to make a concrete chimney cap to place on top of the chimney. A convenient way of doing this is to cast the cap on the ground in the same way as a well cover, described on page 61. Make openings in the right position and of the right size to fit the flues of the chimney. Chimney caps are usually made about 3 or 4 inches thick and slightly larger than the body of the chimney so as to project on all four sides to give a good architectural effect. For large chimneys the cap might be too heavy to raise into position, in which case it would be best to make the cap in place instead of on the ground.

A pleasing effect often can be secured by embedding ornamental clay chimney pots in the chimney cap. These are of various ornamental shapes and project above the top of the cap.

Improving the Cellar—If the cellar has a dirt or

cinder floor install a concrete floor as directed on page 33. If the cellar is dark and unsightly it can be improved by plastering the inside surface of the wall with Atlas White mortar. This can be washed down at any time with a hose, without damaging the mortar.

Overcoating and Remodeling with Stucco—Many old houses have frames which are structurally sound and good for many years of service. The outside wall covering may be in poor condition. Stucco made with Atlas White Portland Cement is an ideal means for bringing such houses up-to-date in appearance, whether walls are of brick, stone, shingle or clapboards they can be covered with stucco. Any structural changes or additions which are desirable can be made and the stucco employed in bringing the entire house to the same appearance. The saving in painting and in fuel consumption will soon more than pay for the cost of the stucco overcoating. Send for our book describing methods of remodeling old houses with stucco.



Figure 159—A concrete trash receptacle teaches the young folks to keep the grounds tidied up and free of litter.

Improvements for the Grounds

Walks and Paths—Concrete walks are described on page 29. Sometimes owners find that only a path one or two feet wide is necessary for leading from the house to the garage, or in similar locations. These narrow paths can be constructed the same as sidewalks, or if the owner likes to do this sort of work, the path may be made of concrete slabs which can be made in the cellar during the winter and carried out in the spring to the proper location. If this is done the slabs should only be made 2 inches thick and small enough for easy handling. Bear in mind that for each square foot 2 inches thick a concrete slab will weigh 25 pounds. A slab 2 feet by 2 feet would weigh about 100 pounds, which is a convenient weight to handle. Obviously this method of making precast slabs is only suitable for narrow footpaths. Use a mixture of 1 part Atlas cement, 2 parts sand and 3 parts pebbles or broken stone.

Brick and Flagstone Walks—Some owners wish to use brick or flagstone walks to carry out landscaping effect and to give a rustic and unstudied appearance. Brick walls should always have a concrete foundation and it is preferable also for flag walks to be set in concrete. The foundation should be of 1:2½:5 concrete and the joint mortar, if used, should be made of 1 part Atlas cement and 3 parts of sand.

Arbors and Pergolas—Nothing adds more to the appearance of the grounds surrounding a house than an arbor or pergola covered with shady green vines. If the posts and other parts are built of wood they must either be kept painted or rotting will make it necessary to replace them frequently. Painting is difficult because the vines completely surround posts and horizontal pieces. Concrete is the solution of this problem because it does not rot and does not require painting.

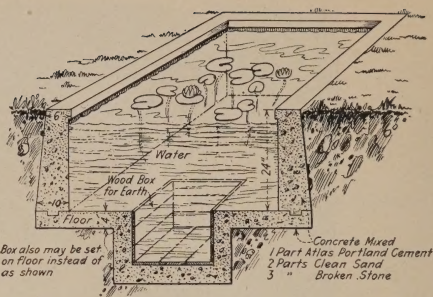


Figure 161—Drawing of a section of concrete lily pool with arrangement for removable box.

General directions for making fence posts (see page 68) should be followed for making the various parts of arbor or pergola. The horizontal pieces may be made of wood or of concrete. If they are made of concrete they must be reinforced with steel bars to bear their own weight. For spans up to 10 feet use two ¾-inch round steel rods located 1 inch up from the bottom of the beam. A good size for this horizontal piece is 2 inches wide by 4 inches deep. Horizontal pieces may set in notches in the posts or be fastened in any other convenient way.

If Atlas White Portland Cement is used for making the concrete parts of an arbor or pergola the white or light colored concrete forms a charming contrast with the green of the foliage.

Lily Pool—If there are small children in the family no more interesting part of the grounds will be found than a combined lily pool and fish pond. Here the small son of the family can study aquatic life in the form of gold fish, minnows, and perhaps a chance-caught small turtle. Lily pools are made in the same general way as tanks and troughs. Figure 161 shows an arrangement for providing for the removal of the lily roots during the winter months when the pool is dry. Be sure to provide inlet, outlet and drainage pipe before pouring the concrete. If a rustic effect is desired the top of the concrete walls may be covered with flagstones which project an inch or two over the inside surface of the wall.

Lawn Roller—A concrete lawn roller may be made without a great deal of trouble if some sort of cylindrical form of the right size is at hand. For example, a small circular oil-can or oil drum, a section of clay drain tile, or sewer pipe,

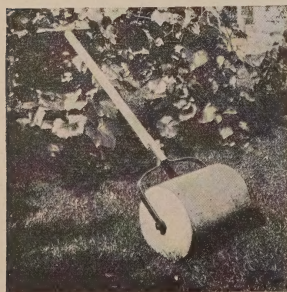


Figure 160—A small concrete lawn roller. Be sure to read directions on this and the adjoining page relative to weight of concrete, so that the roller will not be too heavy.

or an old circular ash-can may be employed for making the roller. Be sure to center the shaft accurately before pouring the concrete. Do not make the roller too large, as concrete is very heavy, weighing 150 pounds for each cubic foot. This means that a roller 15 inches in diameter by 2 feet wide would weigh almost 375 pounds.

Garage, Garden House and Other Small Buildings—Construction of these structures are covered in page 81. See pages 31 and 33 for directions on driveways and garage floors.

Garden Furniture and Ornamental Concrete for the Lawn

—There are many varieties of lawn ornaments and garden furniture which add greatly to the beauty of the house grounds. Benches, urns, flower boxes, sun dials, bird baths and statuary when judiciously used and artistically placed add delightful items of interest to the lawn and garden. Atlas White Portland Cement gives a white marblelike appearance to such ornamental concrete which makes its use almost a necessity. A great deal of skill and experience is required in making ornamental concrete, so that it is best for the home owner to purchase these objects rather than to attempt to make them.

Swimming and Wading Pools—When space and water supply are available a swimming pool is an unending source of comfort and enjoyment during the summer months. See page 67 for drawing of pool. Send to the Atlas Technical



Figure 162—A sturdy concrete post for the clothes-line. This post gives ample support and will not rot out.

Department for book on swimming pools with suggestion designs or any other information required. Even on a moderately small grounds sufficient space may be found for a small wading pool for the children. Lined with Atlas White Portland Cement it presents a sanitary and inviting appearance, and provides a safe recreation spot for the small tots.

Tennis Courts—Tennis players who have used concrete tennis courts say that play is much faster than on ordinary courts and that the ball bounces faster and truer. Concrete tennis courts are usable in any weather and may be put into play in only a few minutes after rain has ceased falling. Concrete tennis courts may be tinted almost any color to prevent glare. Write for information and book describing the layout and construction of concrete tennis courts.

Retaining Walls for Terrace—Nothing is more unsightly than a steep bank along the sidewalk where grass does not grow well and earth is constantly bare. For such locations a concrete retaining wall is a big improvement. See page 74 for information on retaining walls.

Miscellaneous Uses—The use of concrete for miscellaneous uses around the home such as culverts, cribs, sidewalks, fence posts, gate posts, etc., are covered in various sections in the preceding pages. If not fully described, write the Atlas Technical Department for more complete information.

Chapter 6—Atlas Portland Cement

Concrete dates back to the Romans. They secured good results with concrete made of a mixture of slaked lime, volcanic dust, sand and broken stone. This combination, though crude in comparison with the Portland cement concrete of the present day, produced an artificial stone which has stood the test of nearly 2,000 years. Many works and roads of concrete built in Italy and Southern France long ago are to-day in a fine state of preservation.

Portland cement is of modern origin. Joseph Aspdin of Leeds, England, took out a patent under date of December 15, 1824, for the manufacture of Portland cement. It was so called because it resembled in color a well-known

limestone quarried on the Island of Portland, which was then considered the hardest stone known. The manufacture of Portland cement was begun in 1825, but the progress was slow until about 1850 when, through improved methods and general recognition of its merits as a building material, its commercial success was assured.

About this time the manufacture of Portland cement was taken up by the French and Germans, and by reason of their more scientific methods, both the method of manufacture and the quality of the finished product was greatly improved. The first German Portland cement works were built in Stettin in 1855.

Portland Cement in America

Portland cement was first brought to the United States in 1865 and was first manufactured in this country in 1872.

The advance of the American Portland cement industry during the last two decades has been one of the marvels of the age. From a very small beginning the Americans came very rapidly to the front and with improved methods and appliances forged ahead until today the American Portland cements are superior to any others in the world. Not only this, but the section of the State of Pennsylvania in which our Northampton Mill is located, produces by itself more Portland cement today than any two European countries.

In the early days in Europe, as well as in the United States, Portland cement was burned in dome kilns, much like those used for burning lime, the mixture in various stages being put into these kilns with alternate layers of coal or

coke. The output of such a kiln was seldom more than 100 barrels a day. This process was continued until the early nineties, when The Atlas Portland Cement Company began experimenting with a steel cylindrical tube, known as the rotary kiln. It was rapidly developed by this Company and is being used today for calcining Portland cement in every mill in the United States and is gradually being adopted in Europe. These rotary kilns produce from 500 to 3,000 barrels per day, according to their size. More than anything else they have been instrumental in reducing the cost of manufacture to such an extent as to make Portland cement a most economical building material.

Modern Portland cement is a chemical compound. It is manufactured from a mixture of two materials, one, a limestone or a softer material like chalk, which is nearly pure lime, and second—shale, which is like clay, or else clay itself. Portland cement can be manufactured

anywhere that these ingredients are found. But it cannot be manufactured without the one material which is largely limestone and the other material which is largely clay, and the two materials must be mixed in very exact proportions determined by tests, the proportions being changed as often as necessary to allow for any variation in the chemical composition of the materials. In the Lehigh Valley, Pennsylvania, where a substantial proportion of the entire output of the country is manufactured, there are extensive natural deposits of what is known as cement rock, which contains the ingredients needed in practically the proper proportions for the manufacture of Portland cement.

To manufacture Portland cement the raw materials are quarried, crushed and pulverized,

mixed in the proper proportions, and the pulverized raw materials of the correct chemical composition are then fed into rotary kilns, where the mixture is burned to what is known as cement clinker.

Briefly described, a rotary kiln is a steel cylinder 6 to 12 feet in diameter and from 60 to 250 feet in length. It is continuous in operation—the raw material is fed into one end, and by reason of the inclined position of the kiln and its rotary motion the material is passed to the lower end and discharged. During the passage of this raw material from one end of the kiln to the other, perfect calcination is obtained by means of an air blast, the coal being set on fire as it enters the kiln. The clinker resulting from the burning of the raw material in this way is then cooled and pulverized and becomes the Portland cement of commerce.

Atlas Portland Cement

Wonderful as the advance of the general industry has been, the growth of The Atlas Portland Cement Company has been even more remarkable. Beginning in 1892 at Coplay, Penna., with a manufacturing capacity of 250 barrels per day, its production has steadily increased through the various plants at Northampton, Penn., Hannibal, Mo., Hudson, N. Y., Independence, Kan., and Leeds, Ala., until now the productive capacity of The Atlas Portland Cement Company is more than fifty thousand barrels each day, or approximately eighteen millions a year—with a storage capacity of over four million barrels. The locations for The Atlas plants were made with two points in view, the primary consideration being proximity to the best known raw materials, and the secondary, advantages from a trade standpoint. At Northampton a fence built closely around the entire property would enclose about 213 acres. When in full operation the Northampton plant consumes about 9,000 tons of raw rock and 2,000 tons of coal per day and employs 2,700 men. These figures, which concern the Northampton plant alone, give an idea of the great size of the Atlas plants as a whole. By virtue of its enormous production The Atlas Portland Cement Company is able to develop and retain in its service the most skilled operating talent in the Portland cement industry, which ensures

in Atlas a thoroughly reliable and uniform product.

The methods of manufacture of Portland cement developed and perfected by The Atlas Portland Cement Company have been continued with the greatest care and to such an extent that these methods are accepted as standard by practically every other cement manufacturing company. In the manufacture of Atlas Portland Cement the raw materials are carefully selected and carefully mixed after automatic weighing machines have weighed exactly the right quantity of cement rock and the right quantity of limestone. These materials are then mixed thoroughly by automatic mixers, which are constantly controlled by chemists in charge of the operation, not only during the day as is done by most of the companies, but *night and day*. With this control, the mixture never varies. In fact, at the Atlas plants from the time the rock is quarried until the cement is packed into bags and barrels, the work is done by machinery controlled by experts in all its stages. In plain words, we manufacture cement scientifically and not by accident. The finished product also is constantly tested and the mill never operated for a moment without the control of the mill chemists.

One grade of cement only—the highest—is manufactured, and every barrel shipped from

the Atlas mills not only meets all standard specifications for Portland cement, including those of the Bureau of Standards of the United States Government, but also complies with Atlas

specifications, under which each of our mills operates and which are more severe and more exacting than the requirements of standard specifications.

Atlas White Non-Staining Portland Cement

Atlas-White Portland Cement is a true Portland Cement. Its chemical composition is practically identical with that of Atlas Portland Cement, except that Atlas-White is free from the elements that cause the gray color of the regular Portland Cement. The strength of Atlas-White is equal to that of gray Atlas, and is guaranteed to meet the standard requirements for Portland Cement. It is, therefore, a true Portland Cement that has the same physical characteristics as the gray Atlas and may be used with the same manipulation and for the same class of work where a white color is desired.

Atlas-White was placed on the market for the purpose of supplying the demand for a high-grade white Portland cement that was non-staining and could be used where a white or light tone effect of coloring was wanted. Its nonstaining property makes it desirable for setting and pointing fine textured stone such as marbles, light granite, etc. It will not stain or streak these natural stones, and they are as

firmly cemented together when bedded or set in Atlas-White as if they were one solid stone.

Atlas-White is also used in all colored cement work where true color tones are desired. It is white, and therefore gives the true color value of colored aggregates or coloring pigments. In all decorative cement work, either exterior or interior, Atlas-White has afforded the opportunity of color and soft tone effects never before realized in cement construction.

The use of Atlas-White for colored stucco and other purposes is explained in detail in other booklets issued by the Atlas Portland Cement Company, and these will be furnished upon request to those who are interested in this class of work. What is said on page 2 of this book applies to problems in the use of Atlas-White as well as to Atlas Portland Cement.

In using Atlas-White it should be remembered that if a pure white effect is desired, it will be necessary to use an aggregate (sand) with it that is also white.

The Atlas Portland Cement Company

Before you begin work

run your eye down this page—to make sure there's nothing you've forgotten, for it's awkward to get half-way through with a piece of work and find you haven't the necessary material or tools for the next step.

This list includes *all* the important things you would need for *all* sorts of jobs. For any *one* job, you will need only part of them.

Do you know?

- how deep to excavate
- how much you need of each material (see pages 10-11)
- how to proportion the materials (see page 9)
- what reinforcing, if any
- if materials are of good quality (see pages 7 and 8)
- whether you need two sets of forms
- how to finish the surface (see page 18)
- how to get damp-proof walls (see page 19)
- how to work in cold weather (see pages 20 and 87)
- how to bond new work to old (see page 19)
- how to provide openings in forms for windows and doors
- how to provide bolts in concrete for fastening doors, etc.
- how to get corners square (see page 22)
- how to protect concrete (see page 13)
- when to remove forms (see page 15)

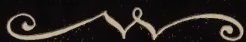
Have you these materials?

- Atlas Portland Cement (see page 5)
- Sand (see page 6)
- Gravel or crushed stone (see page 8)
- Clean water (see page 9)
- Planks for mixing board (see page 12, paragraph 49)
- Boards for forms (see page 15)
- Grease for forms
- Nails or bolts
- Boards for runways
- Wire, mesh or rods for reinforcing
- Canvas for protection (see page 13)

Have you these tools?

- Shovel and pick for digging
- Pails and barrels for water
- Screen for washing and grading (see page 7)
- Hoe for mixing
- Wheelbarrow for carrying
- Ladder for tall construction
- Hammer and saw
- Hand level
- Bit and brace
- Wrench
- Paint brush—to apply grease to forms
- Pliers to handle wire or reinforcing metal

**DEPENDABILITY
AND
PERMANENCE
THE TRUE MEASURE
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ATLAS

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ALL OTHER MAKES ARE
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